SPACE STANDARDS AND FLEXIBILITY IN HOUSING FORMS

AN INVESTIGATION OF SYSTEMATIC DESIGN CONTROLS FOR THE GENERATION OF THE MINIMUM SPACE STANDARD ADAPTABLE HOUSE PLAN

Ph.D.

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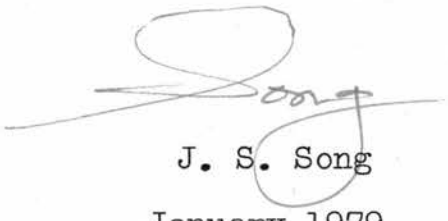
STATEMENT

I declare that this thesis is my own original work



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ABSTRACT

This thesis is aimed at formulating a theory of the generation of rectangular single storey house plans using minimum space standards.

Its purpose is to eliminate unused space in the design process in order to generate a range of house plans from which architects, planners or future occupants might make a selection appropriate to specific needs.

In this study theoretical and methodological aspects which underlie the establishment of a quantitative area/dimension relationship are investigated.

Generally in rectangular geometrical arrangements, problems arise in architectural design in the fitting or 'packing together' of rooms into a plan within a certain range of shapes and dimensions. These problems are further complicated by the need to satisfy within the geometrical arrangement, certain required topological relationships between rooms.

The method places emphasis on two aspects: first, the inter-dependence of minimum room dimensions and house-plan for different family sizes and with varying degrees of functional segregation; secondly the possibility of change in occupants' requirements necessitating flexible room arrangements or the adjustment of the size and configuration of the plan to arrive at an optimum solution.

To investigate the general validity of the theory, the method is applied to both the U.K. and Korea, recognizing

the important cultural differences between these two countries.

It is possible to derive the overall plan outline - the shape of a building's perimeter - in two distinct ways. Either the building is designed from the inside outwards - rooms are assembled according to specified criteria, so that the final building shape is merely the end result of this process, or else the external form of the building is determined first on quite different grounds, and then, like an empty container, is filled with rooms.

In this thesis, the systematic generation of the minimum space standard adaptable house plans is considered in conjunction with both of these approaches.

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1. THE PROBLEM AND THE PROPOSED SOLUTION.

The design and construction of housing present some of the most urgent problems which face us today as the world population increases, living standards rise, and resources diminish.

The challenge to be faced is to satisfy human needs with the least delay, with the smallest number of mistakes, and with the most economic use of space, materials, energy, land, man-power and money. In order to tackle this problem it has become essential for the designer to acquire a detailed knowledge about an effective minimum space standard house in which unused space is eliminated as far as possible.

The 'Metric Shell' (NBA, 1968) was drawn up as one of the most significant, systematic design solutions which demonstrates a selection of generic kitchen/bathroom/bedroom relationships plus certain variations of frontage or depth, number of rooms and in some cases partition or rearrangement of the room plan.

Architects and planners in Europe and other countries have discussed extensively the need for designing an adaptable and flexible support structure (Habraken, 1961), which allows for the occupants' changing needs and preferences. The above named 'Metric Shell' fails to achieve this desired flexibility.

In this study it is hoped to develop a metric shell, modified in the following manner, i.e.

(i) More compact but with a more efficient use of space.

(ii) More built-in flexibility, covering flexibilities of the following kinds;

a) Allowing for different dimensions or configurations of the rooms, given that the area remains constant.

b) Allowing the possibility of different number of cells (rooms) - this is closely related to family sizes, and the desired degree of functional segregation.

There are two aspects involved. First, the interdependence of minimum room dimensions and house plan for different family sizes and with varying degrees of functional segregation. Second, the possibility of change in occupants' requirements necessitating flexible room arrangements or adjustment of the size and configuration of the plan to arrive at an optimum solution. To satisfy these requirements, the geometric frame plan consisting of several spatial units was devised. Attention is confined to single storey rectangular plan forms, because this seems likely to remain the predominant house form in Korea; being also a feasible and quite common solution in the U.K., comparative analysis is straightforward and certain specific criteria appropriate to the different cultures of the U.K. and Korea are applied.

2. OBJECTIVE OF INVESTIGATION.

The aim is the maximum elimination of unused space in the design process of the minimum space standards house plan in order that architects, planners or future occupants

are able to choose an appropriate, flexible, space standard house plan from the available selection without difficulty or confusion.

3. LAYOUT OF THE THESIS.

The thesis is presented in seven chapters. First is an introductory chapter outlining the area of study, and the second is a review of previous studies by various researchers. The main arguments and investigations covered by the thesis are presented in the remaining chapters.

Chapter III deals with the definition of the basic terminology adopted, and sets out an overall conceptual framework. In Chapter IV the idea of a modular discipline for the adaptable structure, using geometrical analysis is developed. Chapter V deals with the planning and design of the room as a compact unit, and evaluates possible variation in the area/dimension relationship within given constants. Chapter VI gives a range of adaptable house plans which result from the investigations of this thesis. It also briefly covers plot plans and their relationship to house plans. The final chapter, Chapter VII summarizes the investigation and suggests areas for further investigation.

CHAPTER II

REVIEW OF PREVIOUS STUDIES

1. INTRODUCTION.
2. SPACE STANDARDS.
3. FORMULATION OF HOUSE PLAN WITH ROOM COMPONENTS.
4. ADAPTABLE STRUCTURE FOR CHANGING NEEDS.
5. OPTIMUM SHAPE OF HOUSE PLAN.
6. SPACE AND FORM OF KOREAN HOUSE.
7. SUMMARY AND CONCLUSIONS.

1. INTRODUCTION.

This chapter is not intended to be a fully comprehensive review of earlier work on space standards, but the formulation of minimum space standards which can be applied to all house plans is discussed, with particular regard to the flexible plan proposed in this thesis. There are three requirements to be fulfilled in this formulation:

(i) A specified size for a room or for the overall plan of the home, conceived as the minimum space standards required for households of varying sizes.

(ii) Some arrangements for packing the rooms into a particular shape of house plan.

(iii) A method to adjust the house plan to suit the changing needs and changing circumstances of the householder.

Studies of house plans in Europe and Korea are introduced in chronological order.

2. SPACE STANDARDS.

2.1 General.

For the European architect or housing expert, the term 'space standards' usually connotes the amount of floor space or the number of rooms in the house related to the number of occupants, which will ensure a degree of privacy and comfort. The units which have been devised for this purpose, reflect this concept of space standards, e.g. floor space per person or per family or number of persons per room.

Floor space gives a precise measure of the amount of living accommodation. It is normally measured inside the external (or party) walls and includes the thickness of internal partitions, all rooms, covered balconies and verandas, and service and circulating space, but excluding all external and common stairs, lifts, corridors, etc. This definition conforms as closely as possible to those in current use elsewhere, e.g. 'net dwelling area' in the United Kingdom, and 'gross area' in the housing studies of the United Nations Economic Commission for Europe. The only difference is the U.K. and E.C.E. definitions do not include covered balconies and verandas.

Floor space having been adopted as the measure of accommodation, the rate at which it is occupied by people may conveniently be expressed in terms of a 'floor space rate', i.e. so many square feet or square metres of floor space per person.

There can be no standard guide to the floor space rates appropriate to various circumstances. Studies of surveys relating to different housing conditions throughout the world reveal figures ranging from 12 sq. ft. ($1.1m^2$) per person in many congested areas of Asian cities to 150 sq. ft. ($13.9m^2$) and upward in middle and upper income group housing generally. Standards adopted in government, local government, and other statutory and private building programmes also demonstrate a wide range of floor space rates, from an average of 24 sq. ft. ($2.2m^2$) per person in Hong Kong to about 150 sq. ft. ($13.4m^2$) and upward in Western Europe.[1]

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1. P.H.M. Stevens, Densities in Housing Areas, 1960, (p.16).

Table 2.1 gives some selected floor space standards derived from studies of housing and housing policies in various parts of the world.

Table 2.2 gives a selection of some of the low floor space standards which have been recorded by surveys of living conditions in various places.

Studying these figures it is apparent that, when faced with low floor space rates, accurate control of the amount of accommodation in an area is essential if population targets for that area are to be maintained and the social objectives of the plan achieved with any reasonable degree of success.

Occupancy standards should be chosen which take account of prevailing social and economic conditions; a too optimistic view in choosing standards will almost certainly result in failure, and may also encourage the abuse of codes or controls intended to bring about improvement in conditions of overcrowding. In deciding new floor space rates for a particular area, planners will require to study very carefully existing rates for various classes of accommodation and different social and economic groups within the community.

The floor space standard fails to give a complete picture of actual living conditions. In tropical countries especially, outdoor living is both practicable and desirable.[1] The garden of the compound house provides more than mere recreation and occasional use for clothes drying and storage,

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1. For a further discussion of this subject see: El Bedri Omer Elias, Space Standards in Low Cost Housing with Specific Reference to Urban Areas of Central Sudan, 1970.

Table 2.1
Examples of Floor Space Rates

Country and source of information	Floor space rate (sq. ft per person)	
	Range	Average
1. *Hong Kong* (1955): Squatter resettlement tenements (i)	—	24
2. *West Indies* (1944): Recommended for new low-cost housing (ii)	—	48
3. *India* (1946): Health Development Committee, recommended minimum (iii)	—	60
4. *Kenya* (1943): Makongeni, Nairobi (iv)	—	70
5. *South Africa* (1951): Urban Bantu housing based on revised minimum standards of housing accommodation for non-Europeans (v)	82–103	90
6. *West Germany* (1948): Emergency post-war housing (vi)	86–108	97
7. *Poland* (1953): Newly built flats in Warsaw (vii)	95–121	108
8. *Latin America* (1953): Recommended minimum for social housing (viii)	108–130	119
9. *Greece* (1951): Economic Commission for Europe, housing sub-committee studies (ix)	123–151	136
10. *Ireland* (1951): Economic Commission for Europe, housing sub-committee studies (ix)	138–165	152
11. *Northern Ireland* (1951): Economic Commission for Europe, housing sub-committee studies (ix)	152–166	158
12. *United Kingdom* (1944): Ministry of Works prefabricated bungalow (temporary housing) (x)	155–160	158
13. *Scotland* (1948): Scottish Housing Advisory Committee standards (xii)	131–247	175
14. *England* (1953): Ministry of Housing and Local Government standards for social housing (xi)	161–248	185

Table 2.2
Living Conditions in Various Places

Country and source of information	Floor space rate (sq. ft per person)
1. *Panama* (1953): Typical of worst conditions (xiii)	12
2. *India* (1952):	
Calcutta Bustoes	12
Jute mill quarters in West Bengal	16
Sholapur chawls (xiv)	21
3. *Algeria* (1953): Bidonvilles in Algiers: average occupancy (xiii)	25
4. *India* (1952):	
Bombay chawls	27
Cotton mill housing (xiv)	30
5. *Tanganyika* (1953): Town Planning Commissioner's estimate of average occupancy for Africans in Dar es Salaam (xiii)	40
6. *Yugoslavia* (1950): In towns of more than 5000 inhabitants:	
(*a*) 5% of dwellings	43 and under
(*b*) 24% of dwellings (xv)	44–86
7. *Jamaica* (1943): Census report (average dwelling size/average household) (xvi)	55
8. *West Germany* (1950): Census report (average density of occupation of permanent dwellings) (xv)	86

Source: Stevens 1960 (PP. 16-17)

and becomes a valuable extension of indoor living space with a vital role to play in determining living conditions. The building itself provides the essential shelter from rain, relief from the heat of the sun and privacy when it is needed, but it remains only one part of the total living area. Its occupants can cook, and even take baths out of doors in warmer climates. This also applies to Korea where the compound house is preferred and in summer it is used in the manner of a tropical house. This does not apply in winter when people remain indoors. The compound house and tendency to westernization in Korea is discussed later in part 6.

Therefore, in order to give a true expression of living conditions in tropical areas, in so far as space standards are concerned, Stevens (1960) stressed, that it is necessary to relate floor space to 'total living space'. This can be defined as the total space available on all floors indoors and outdoors within the curtilage of a housing plot or group of housing plots. Floor space rate has been used to define the relationship between people and the amount of floor space they occupy, and the parallel relationship between people and total living space can be defined by a total living space rate (i.e. area of total living space per person).

The importance of the total living space rate increases as floor space rates fall. If, by force of social and economic circumstances, it is necessary that low floor space rates be accepted, it is essential to compensate for lack of indoor space by provision of outdoor living space.

Although this concept of total living space provides an index of living conditions in terms of the total amount of space available, it does not give a readily comparable measure of living conditions in terms of useful space without additional information on the distribution of total living space between floor space/indoor space and between floor space/outdoor space. As dwellings become more remote from outdoor living space, (i.e. westernized house which is the opposite of compound house), there is a greater need for more floor space if living conditions are not to deteriorate.

In cases where excellent amenities are provided, there is less need for people, especially children, to remain indoors as there will be somewhere for them to go outside. Floor space can be reduced in these cases. However, this is not standard and so plans should be designed to cater for the majority of people who do not have these facilities.

Floor spaces rates are not international but differ according to the current living standards of various countries. A comparison of floor space (Dwelling area) recommended by some countries is illustrated in ascending order in Fig. 2.1. It shows a general tendency for rich countries to utilize more space. It can be compared with Fig. 2.2 showing minimum dwelling sizes corresponding to household sizes as recommended by the International Housing Federation (I.F.H.P.) in Cologne.

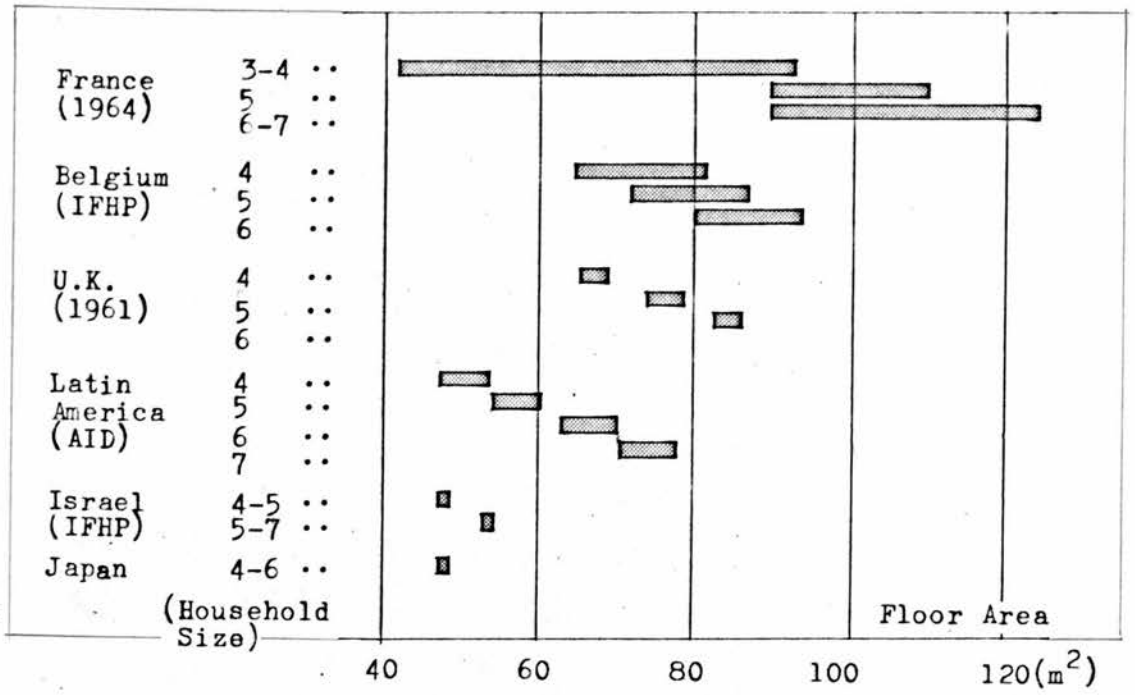
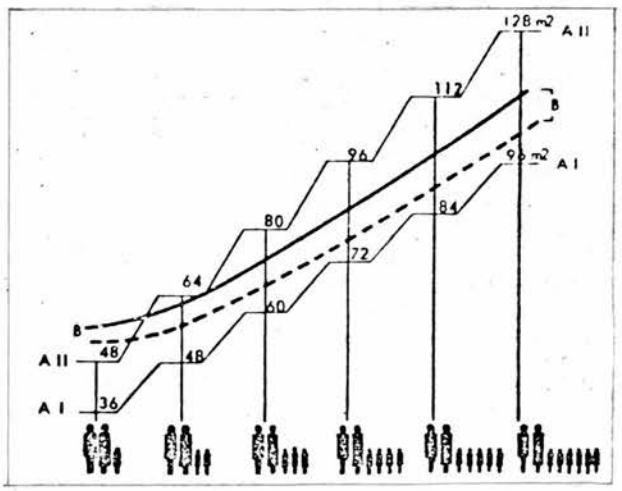


Fig 2.1 Comparison of Housing Standards in Floor Area by Household Sizes in Certain Countries

Sources: See Appendix A(pp. 166-169)



A- Critical thresholds, according to Chombart de Lauwe
A I : 12m² per inhabitant
A II: 16m² per inhabitant

B- Cologne Resolutions ---- Net Surface
—— Gross Surface

Fig. 2.2 Cologne Resolution(IFHP 1957) and Comparison of Minimum Dwelling Sizes by Household Size

An extensive research undertaken by the French sociologist Chombart de Lauwe[1] has yielded the following result: if less than $12m^2$ is allowed per inhabitant, which is the absolute lower limit, abnormal social behaviour could be expected; if less than $16m^2$ is allowed per inhabitant, there would exist a danger of social decline. These thresholds are shown in Fig. 2.2.

Social and economic conditions within each country are not static and allowance must be made for fluctuation, although the general trend is for a constant up-grading of conditions as aspirations rise in step with increases in Gross National Income. Such annual increases may result in increased floor space (Dwelling area) per person; projections by the Korean Industrial Research Development Institute (K.I.R.D.I.) are illustrated in Fig. 2.3. In this diagram, average floor area per person ($7.9m^2$, 1970) for Korea are compared with the U.K.'s standards relating to floor space (e.g. $14m^2$ for 6 persons). Space standards are quite uniform without a great deal of variation caused by such factors as differences in income. In Korea, there is considerable variation depending on the social status and wealth of the occupant. An attempt is being made to regularize this and produce national standards which approach those of the U.K.

Floor space is generally related to household size, space usage, and cultural aspects but these are not constant so the concept of a flexible plan is necessary.

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1. Chombart de Lauwe. Le logement, le menage et l'escape familial (Housing, the household and family space) in Informations sociales, Paris, 1955.

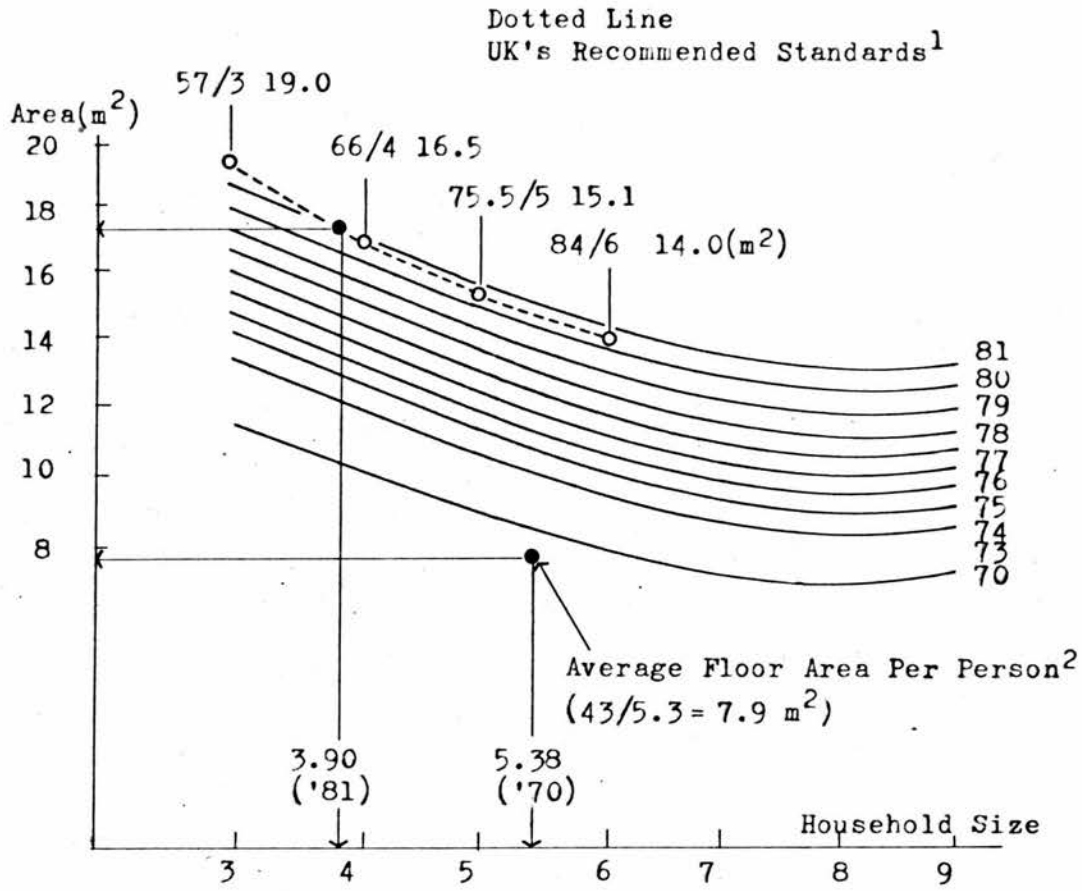

Fig. 2.3 Comparison of The UK.'s Standard Floor Area Per Person and Average Floor Area Per Person Projected by Years (1971-1981) in Large Cities in Korea[3]

Sources:
1. Homes for Today and Tomorrow
2. 1970 Census: Average Dwelling Area 43m² ; Average Area of Habitable Room 6.9m²
3. See Appendix B(p. 170)

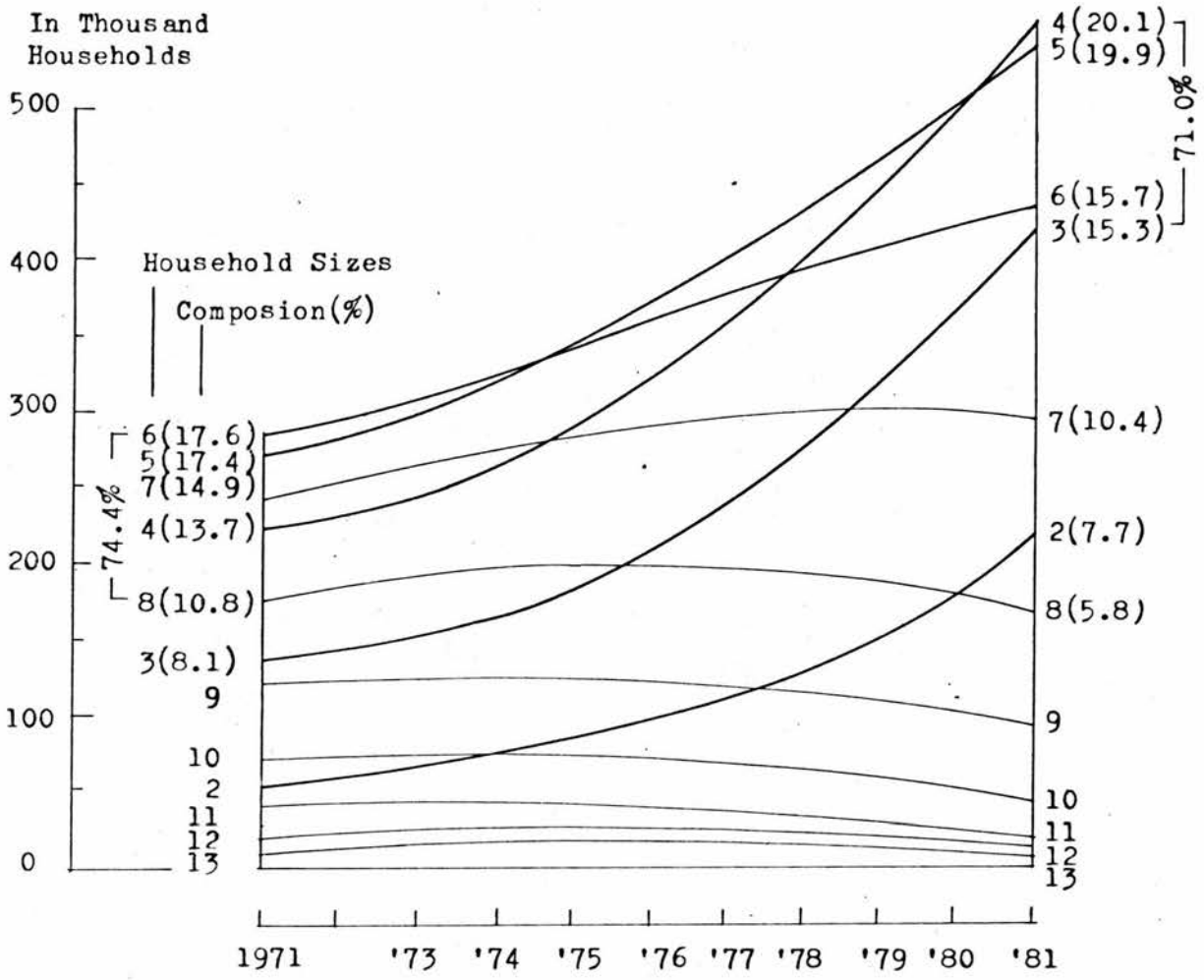

Fig. 2.4 Household Size Distribution Projection (1971-1981) for Large Cities in Korea

Source: Korean Industrial Development Research Institute (1974) See Appendix B (p. 170)

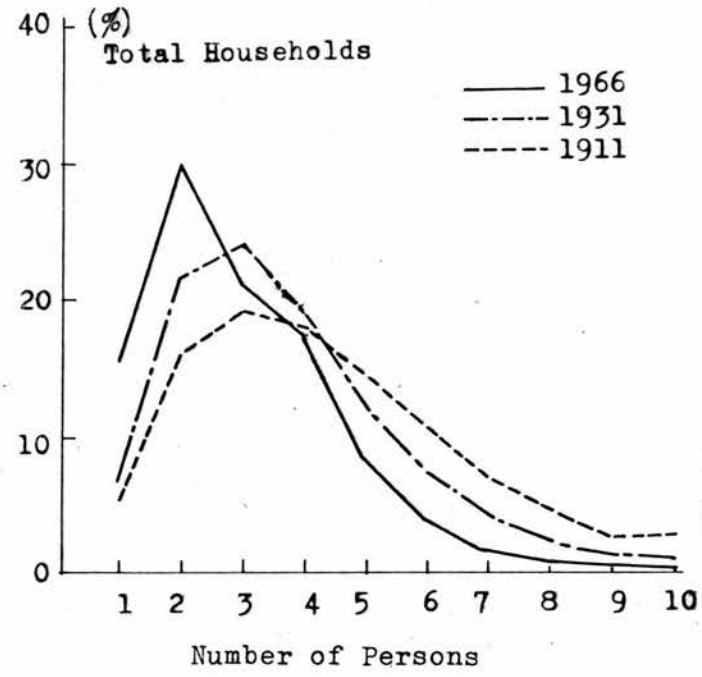

Fig. 2.5
The Size of Private Households in England and Wales 1911-1966

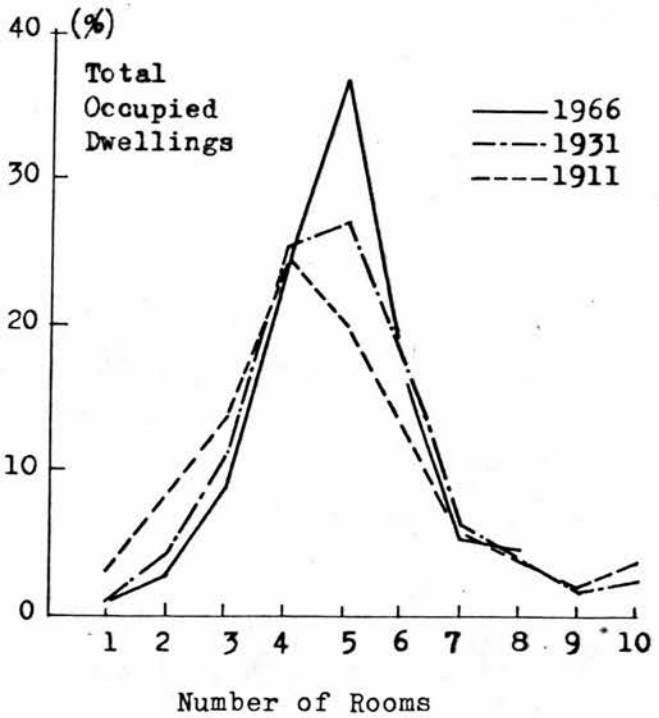

Fig. 2.6
The Size of Occupied Dwellings in England and Wales 1911-1966

Sources: R G Census of England and Wales 1911/1931
R G Sample Census 1966: England and Wales/Great Britain Summary

From: Vere Hole, A Study of Long Term Changes in Standards and Needs for Space in Dwelling, in Architecture and the Social Sciences, University of Ediburgh, 1973.

There is a clear trend in most countries through the world towards smaller families, which results in an unintentional improvement in space standards.

As shown Figs. 2.5 and 2.6, there is a need in the interests of economy, for better matching of household sizes to dwellings but this is an aspect of housing policy, outside the scope of this study. However, the importance of population studies lies in the need to identify the range of household sizes requiring most attention. Fig. 2.4 suggests that in Korea families of 4-6 persons will tend to dominate in future, although there will also be more 2 and 3 person families.[1] The trend towards even smaller families in the U.K. is clear from Fig. 2.5.

The following section covers investigation of minimum space standards and the factors involved.

2.2 Perception Space.

In Korea, people are used to more crowded social conditions than in the West and therefore will accept having to be nearer each other without feeling oppressed. However, having experienced the less intimate distances of western people they are now tending to prefer to have more space around them. They are also beginning to want individual rooms which was almost unknown before.

Perception space is the distance which people prefer to maintain when in company. This distance varies according to the activity in which they are participating, the climate in addition to their customs and traditions. There

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1. See Appendix B (p. 170).

are two kinds of perception space - tactile space and thermal space, but they are related to each other and both may affect space standards.

i) Tactile Space

There are major differences between cultures in the distances that people maintain - English men keep further apart than Frenchmen or South Americans. If North Americans are asked to compare two identical rooms, the one that permits the greater variety of free movement will usually be experienced as larger. There is certainly great scope for improvement in the layout of our interior space.

> 'Like many people, one had a habit of pushing oneself away from one's desk and leaning back in one's chair to stretch one's arms, legs and spine. If one touched the wall when one leaned back, the room struck him as too small. If one didn't touch the wall, one considered it ample'.[1]

Given the fact that there are great individual and cultural differences in spatial needs there are still certain generalizations which can be made about what it is that differentiates one space from another. Briefly, what we can do in it determines how we experience a given space. A room that can be traversed in one or two steps gives an entirely different feeling from a room requiring 5 or 10 steps, which has a bearing on preferred room depths.

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1. Edward T. Hall. The Hidden Dimension, 1969. (p. 51).

ii) Thermal Space

Temperature has a great deal to do with how a person experiences crowding. A chain reaction of sorts is set in motion when there is not enough space to dissipate the heat of the crowd and it begins to build up. In order to maintain the same degree of comfort and lack of involvement, a hot crowd requires more room than cool one. In winter people can tolerate more crowding in smaller rooms which are not too well heated or insulated.[1]

2.3 Combining Activities in Overlap Space Usage.

Overlap space is the floor area which is used for more than one activity or which has a combination of fittings in it, or has fittings and is also used for particular activities. Thus space is saved without restricting activity.

The floor space required for most activities can be divided into two parts: that which is permanently occupied by fittings or equipment, and that which is used for standing or sitting. In the example below - storing clothes - the area occupied by the cupboard is exclusive to that function but the space used to stand in can be used for activities at other times.[2]

Taking a group of ~~three~~ six activities in a bedroom, the shaded areas of the diagram of Fig. 2.7 show clearly the parts that are exclusive to the activity. The activity of 'dressing' does not in fact occupy any space exclusively and there is therefore not shaded. These activities could

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1. For a further discussion of this subject see: Lee K.H. Space Heating and People, 1974.

2. For overlap space in Bathrooms/W.C. see Appendix D (p.174).

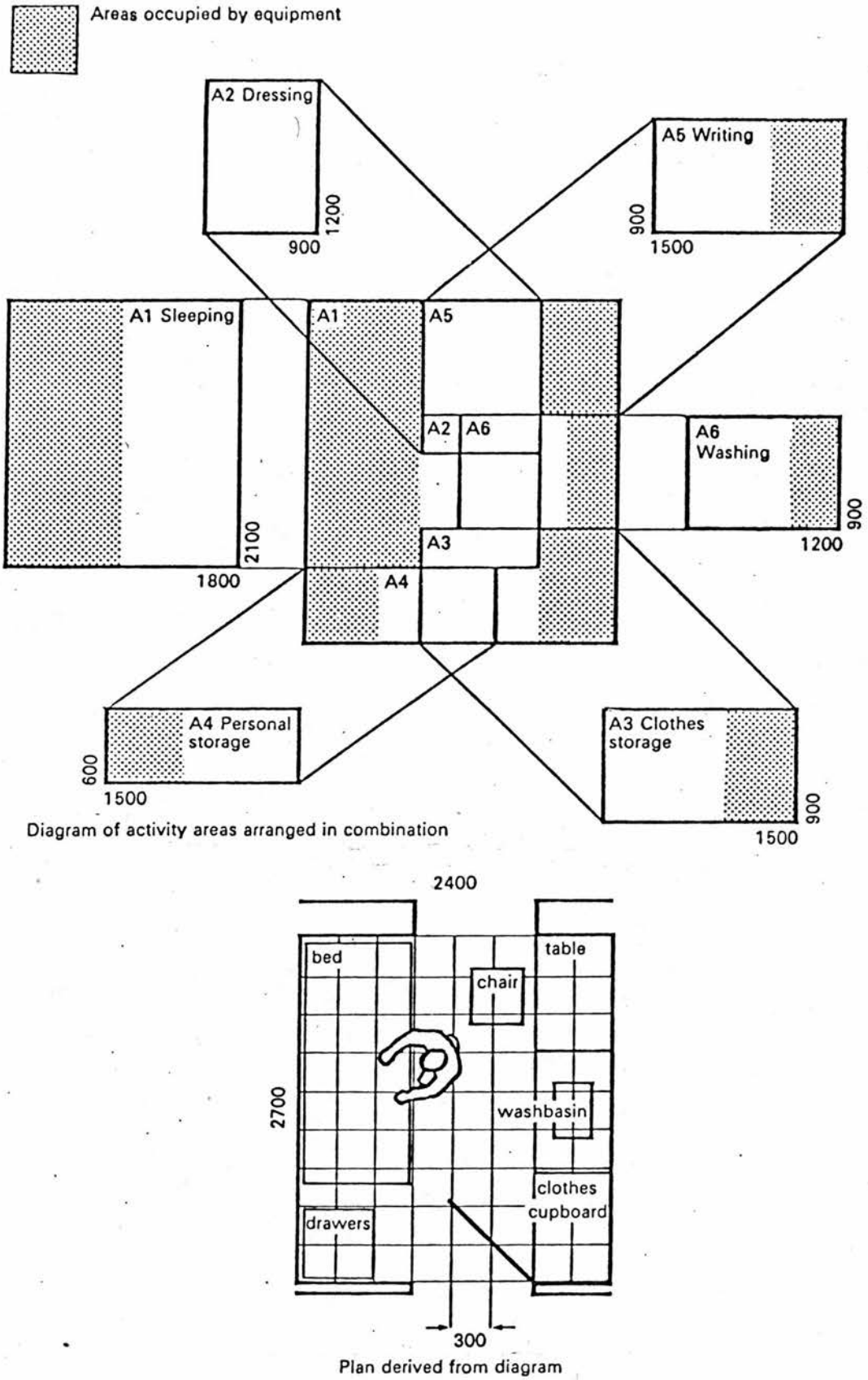

Fig. 2.7 Overlap Space Usage in a Bed Room

be combined in a number of ways, one of which is shown in Fig. 2.7. The shaded area cannot overlap, the unshaded can.

Compact space is produced when the maximum number of activities are combined in one area and fittings are arranged in such a way that space is not wasted. This overlap should not be carried to extremes as this will result in cramped conditions.

In Scandinavian Countries, there must be a standard degree of overlap in house plans submitted for a government subsidy approval.[1]

2.4 Room Area and Dimensions.

Overall dwelling area can be divided into room area and circulation area. A comparison of room areas recommended by some countries is illustrated in ascending order in Fig. 2.8, which confirms that general tendency for rich countries to utilize more space.

Furniture/fittings may determine room sizes and consideration must be given to anthropometrics - adequate space should be allowed for unrestricted movement around fittings.

With regard to this and to varying household sizes, standard room sizes and dimensions were recommended by International Housing Federation (I.F.H.P. Cologne 1957) as shown in Fig. 2.9. This gives a room arrangement suitable for varying household sizes.

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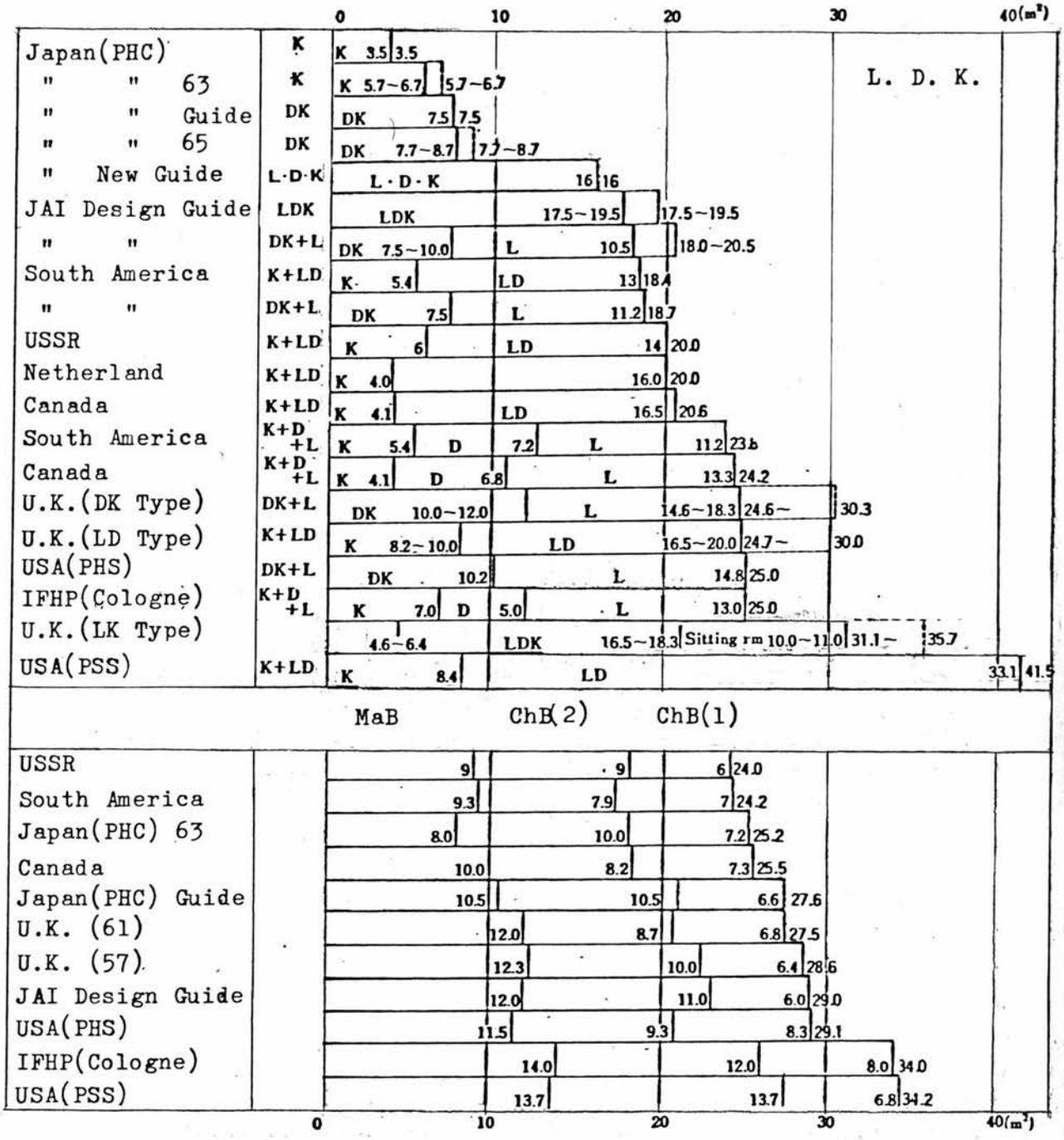
1. Roar Bjørkto, Evaluating the Usefulness of Dwellings (No. 81), 1963.



K, Kitchen
L, Living Rm.
D, Dining Rm.

DK, Dining Kitchen Rm.
LD, Living Dining Rm.
LDK, Living Dining Rm. plus Kitchen

MaB, Master Bed Rm.
ChB(2), Two Children's Bed Rm.
ChB(1), One Child's Bed Rm.

Fig. 2.8 Comparison of Room Sizes Recommended by Certain Countries (3Bed Rooms for 5 Persons)

Source: Suzuki, S.B., Row House. Maruzen in Japan, 1971. P.264.

(m²)

No. of Bed Rm.	2	2	3	3	3	4	4	4	5
Household Size	3	4	4	5	6	6	7	8	8
Kitchen	6	7	7	7	8	8	8	8	8
Living Dining	13	13	13	14	16	16	17	18	18
Ma. Bed Rm.	5	5	5	6	6	6	7	8	8
Ch. Bed Rm.	14	14	14	14	14	14	14	14	14
Ch. Bed Rm.	8	12	8	12	12	12	12	12	12
Ch. Bed Rm.	—	—	8	8	12	8	12	12	12
Ch. Bed Rm.	—	—	—	—	—	8	8	12	8
Ch. Bed Rm.	—	—	—	—	—	—	—	—	8
Bathroom/wc	—	—	—	4	4	4	4	—	—
Bathroom/wc	4	4	4	—	—	—	—	4	4
Wc	—	—	—	1.2	1.2	1.2	1.2	1.2	1.2
Wash Hand	—	—	—	1	1	1	1	1	1
Storage	1.5	1.5	1.5	2	2	2	2.5	2.5	2.5
Extra Rm.	—	—	—	—	—	—	—	(8)	(8)
Total Floor Ar.	51.5	56.3	60.5	69.2	76.2	80.2	86.7	93.7 (101.7)	97.7 (105.7)

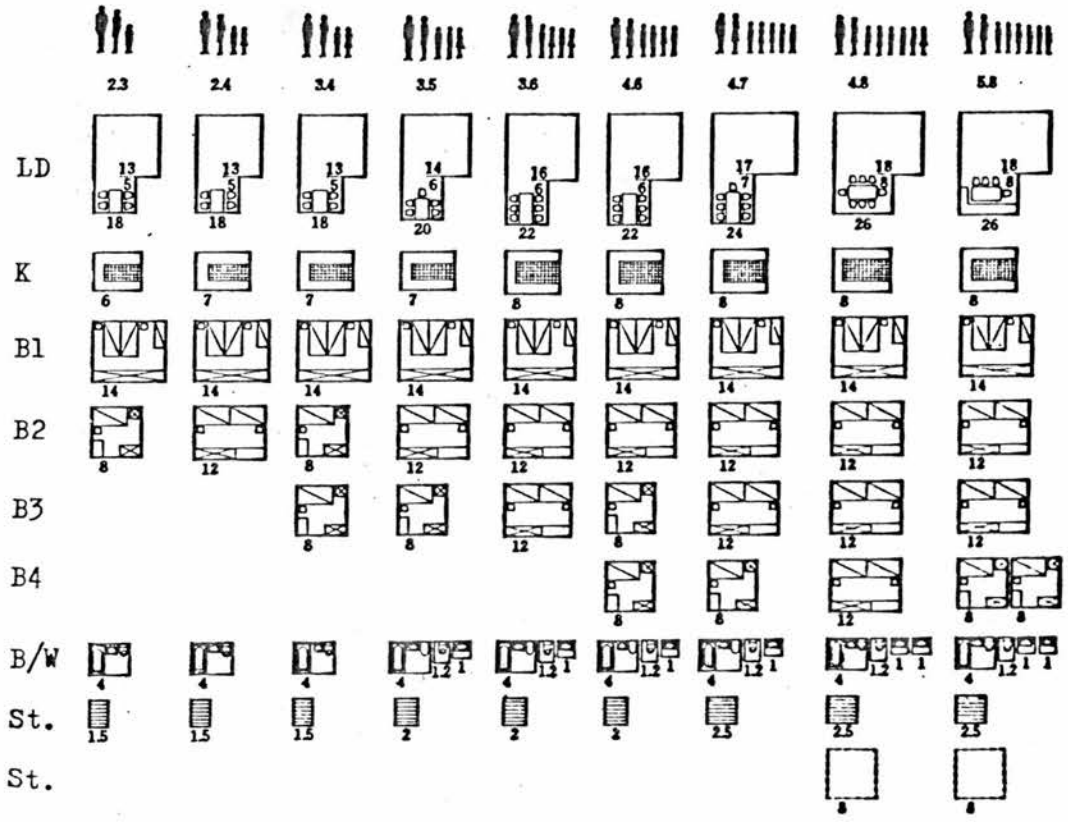


Fig. 2.9 The Minimum Room Sizes and Dimensions Recommended by International Housing Federation(IFHP 1957)

However, it does not allow for variation in room fitting arrangements or location of walls, windows and access points which may affect the room size and dimension and restrict room design. Also there is no indication of the relationship between rooms of varying area and the overall house plan. It is not possible to pack such rooms together in the required overall house plan.

In 1968, the National Building Agency (N.B.A.) in the U.K. presented sample plans for minimum rooms of varying area and dimensions[1] for use in formulating the concept of the 'Metric Shell' which is discussed later on.

Although this was an improvement on previous work, defects still remained. To eliminate these defects, there must be a systematic formula for the adjustment of room design according to specified criteria, such as the location of the window and access point, because this will affect activities and fittings sizes within the room.

Before leaving this topic, it is worth considering the importance of adequate heating in countries with cold climate. The Parker Morris Report drew attention to the effect of improved heating standards on the usefulness of bedrooms and it is assumed that an adequate standard can be achieved throughout all habitable spaces in the following analyses.

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1. See Appendix C (pp. 171-173).

3. FORMULATION OF HOUSE PLAN WITH ROOM COMPONENTS.

Formulation of the house plan can be considered in relation to the following three aspects:

(i) Relationship between circulation space and rooms (i.e. shape, size and number).

(ii) Room arrangement (generic house plan) which will satisfy all required topological relationships.

(iii) Varying overall shape of plan as a 'shell' which should satisfy the given configurations.

In this thesis only double aspect plans in a single storey rectangular frame plan are studied.

3.1 Room and Circulation Corridor.

A study of efficiency in the planning of building in terms of relationship between room and circulation was carried out by Martin and March.[1] There is a common assumption that the most economic building is that in which the circulation space is reduced to a minimum when set against the total floor area: that is to say that maximum efficiency of planning is measured by the relationship of circulation to gross area. This measure is frequently used in assessing cost and awarding grants. At the same time other standards, possibly conflicting, may be introduced, for example room size based on increments, or constructional sizes resulting in modular dimensions. These are all interrelated factors and the

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1. Martin and March, Urban Space and Structure (Speculation 1), 1965. (pp. 31-33).

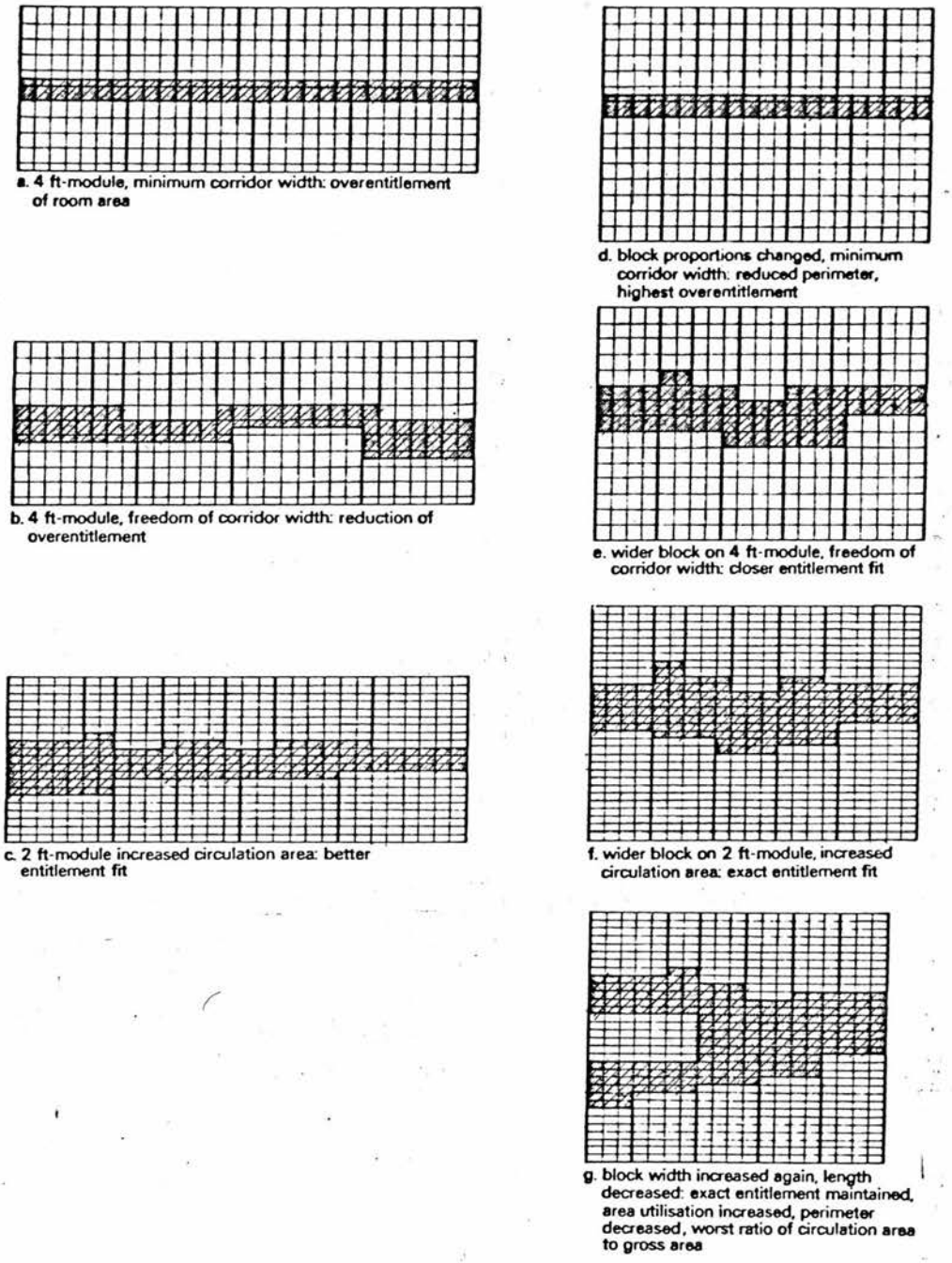

Fig. 2.10 A Comarative Study of Office Layout with Varying Planning Modules, Room Depths, and Perimeter Lengths

Source: Martin and March, Urban Space and Structure. 1965. (p. 33.)

interaction can be studied in a few simple diagrams shown in Fig. 2.10.

The plans are actually of offices, but could be applied to houses as the same design problems are involved. A standard room depth (i.e. all rooms within the plan having the same depth) will produce a more efficient corridor as there will be no wasted space.

To allow maximum interchangeability, room dimensions should be as similar as possible.

3.2 The Metric House Shell.

In order to encourage mutual understanding between those who design houses and those who design systems and components, the National Building Agency (N.B.A. 1968)[1,2] has developed two and three storey houses which can take many different forms without unnecessary variety in span and dimensions. At the same time they demonstrate the degree of flexibility required from systems and components if the real needs of families are to be met.

The formulation of variation of house plan with room components was labelled the 'Metric House Shell'.

There were three significant features in the development of the metric house shell: the system of classifying plans, the dimensional grid, and the space standards used. House plans may be classified in various ways, but two basic approaches were considered: the user's point of view and the construction point of view. Certain basic

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1. The National Building Agency, Metric House Shell - Two-Storey, 1968.

2. The National Building Agency, Generic Plans - Two and Three Storey, 1968.

staircase/kitchen/bathroom arrangements were picked out as being applicable to the majority of design problems that would arise in practice. Thirty-three such arrangements emerge to form what are called 'Generic Plans', refer to illustration of example of generic plan (See Fig. 2.11-2). In nearly all cases, each generic plan has a number of variants (plans differing in frontage, house size, or aspect). Each generic plan plus its variants is called a range, the common feature of which is the staircase/kitchen/bathroom arrangement. The next step was to adjust each generic range to meet standards of area and equipment laid down in the Parker Morris report.[1] Finally, the ranges of plans were reduced to the common dimensional system to illustrate range of 'shell' sizes shown in Fig. 2.11-1 . Several plans in shells of different sizes have similar arrangements which can use standard components or assemblies such as service cores through a related set of four, five and six person houses.

In this process of selection and rationalization, the aim was to strike a balance between the needs of the client and the needs of the builder.

These 'ranges' of plans represent the basic data necessary before design can begin. The user can, after deciding on a frontage, house size, or aspect, find the appropriate plans to suit his needs and then work out adaptations within the fundamental constants of staircase/kitchen/bathroom relationship and dimensional grid (300mm x 300mm).

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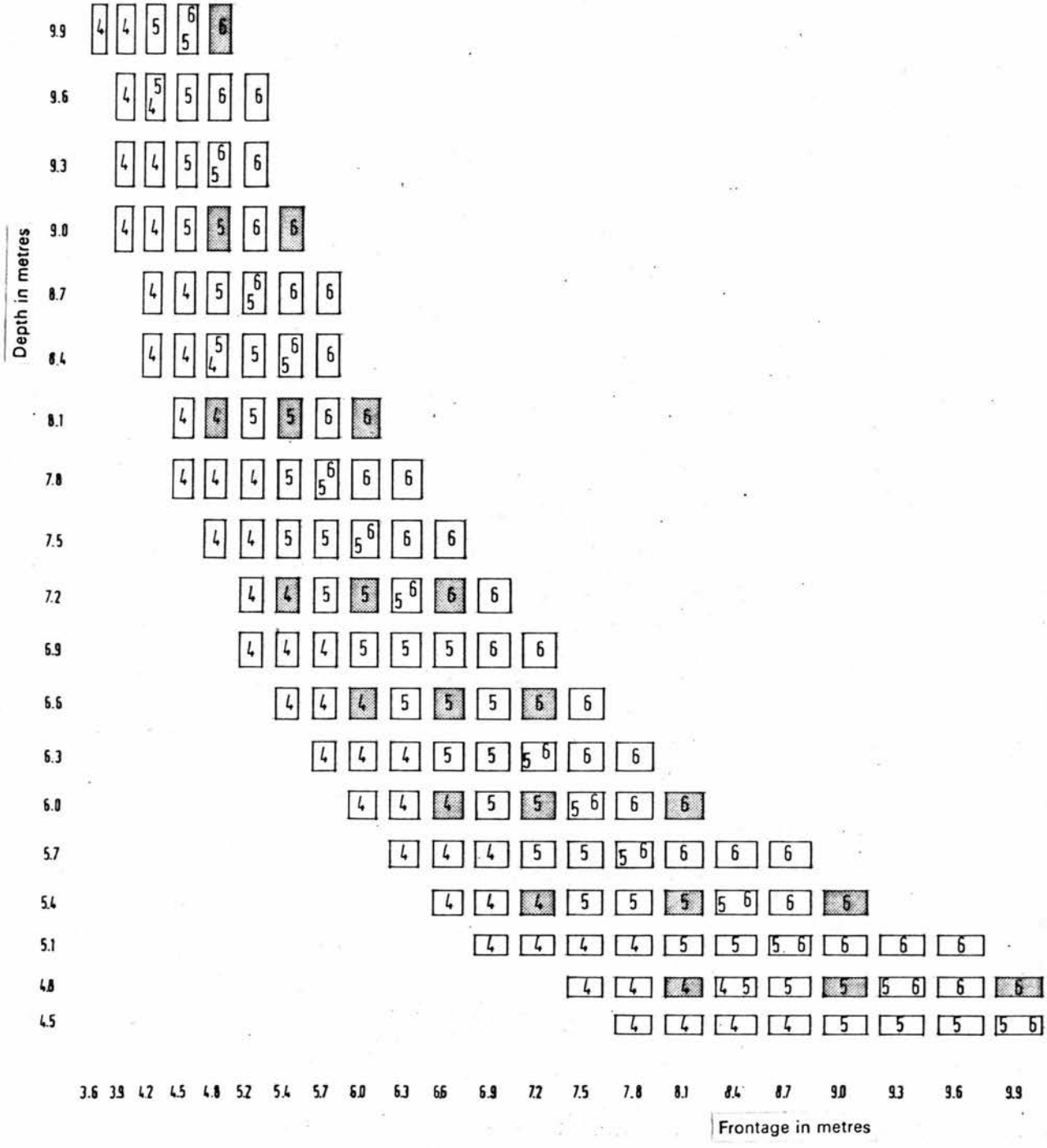
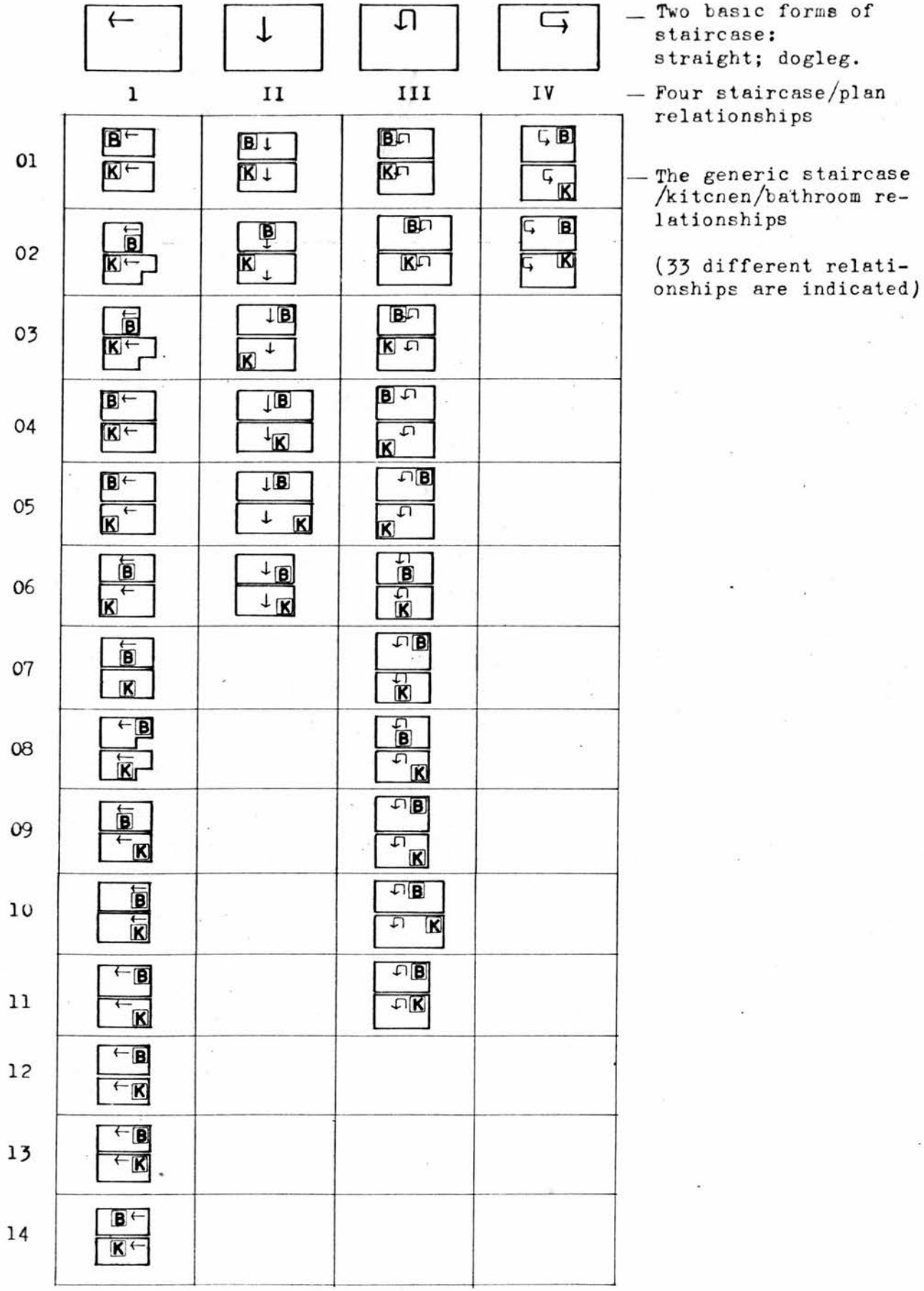
1. Department of the Environment, Homes for Today and Tomorrow, 1961.



The range of four, five and six person metric house shells published in the Ministry of Housing Circular 69/69

Fig. 2.11-1 Shell Dimension of Plans (NBA 1968)



— Two basic forms of staircase: straight; dogleg.

— Four staircase/plan relationships

— The generic staircase /kitchen/bathroom relationships

(33 different relationships are indicated)

Fig 2.11-2 Generic Plan Chart (NBA 1968)

Because priority has been given to providing related sets of plans with similar generic arrangements, it follows that some plans may not provide the best solution when considered on their own and without reference to other plans in their set.

Generally kitchen/dining combinations were preferred to living/dining combinations, and the possibility of subdividing living/dining rooms or double bedrooms was also considered.

The number of ways in which these spaces can be put together on the two floors in a rectangular house of a given area is limited, especially when certain critical dimensions apply to the spaces themselves. These critical dimensions can be derived from the furniture that has to be accommodated within the spaces as given in Circular 1/68.[1]

The positioning of services such as plumbing and heating, and particularly the need to keep drainage compact, is a further factor influencing the ways in which spaces can be arranged within the home.

The most important factor in considering layout is the frontage of the shell. Narrow frontage houses can be built to high densities but have several disadvantages. Very narrow frontages are not included in the shell range but some of the plans have deep rooms which present daylighting problems.

An important factor in any attempt to rationalize close-packed planning is the need to satisfy in the geo-

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1. The Metrication of House Building, 1969.

metrical arrangement, certain required topological relationships between rooms. To tackle this problem Philip Steadman investigated the automatic generation of minimum standard house plan[1] as follows. A modified version of his method, using only one dimensional adjustment instead of two, was applied in this study to investigate the geometric arrangement of rooms.

A series of 'adjacency' constraints are introduced. These specify that in an admissible plan arrangement certain rooms should be adjacent to, that is touch or share some common wall with, certain other rooms.

A series of examples are drawn from house planning, using data from the publications of the National Building Agency's 'Generic Plans and Metric House Shells'.

A curious analogy from the physics of electrical networks is described, whereby 'Kirchoff's laws for electrical flow' are shown to hold true for the relationship of the dimensions and shapes of rectangles in a mosaic or packing together of rectangles such as the architectural plans under study.

The use of permutational methods is proposed, to manipulate a type of 'electrical network' corresponding to the dimensional area and adjacent constraints of a particular planning problem, so as to produce exhaustively all solutions in which such constraints are satisfied (Fig. 2.12).

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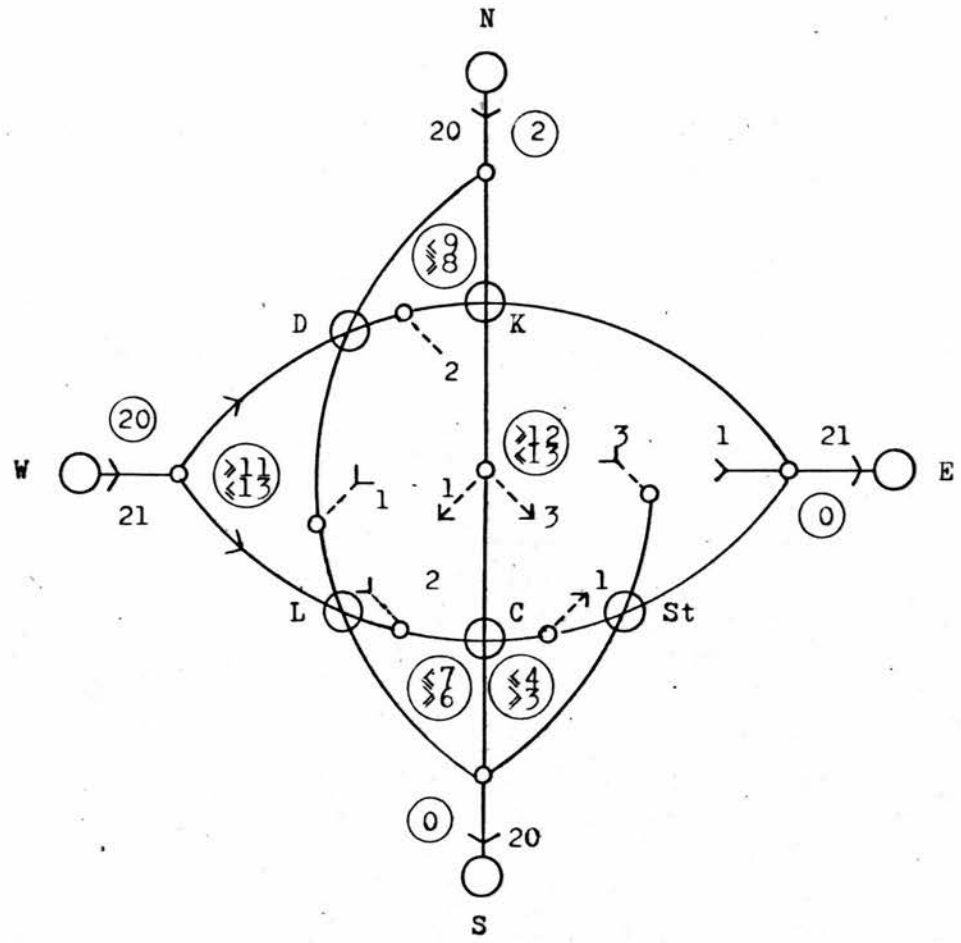
1. Philip Steadman, The Automatic Generation of Minimum Standard House Plan, 1970.



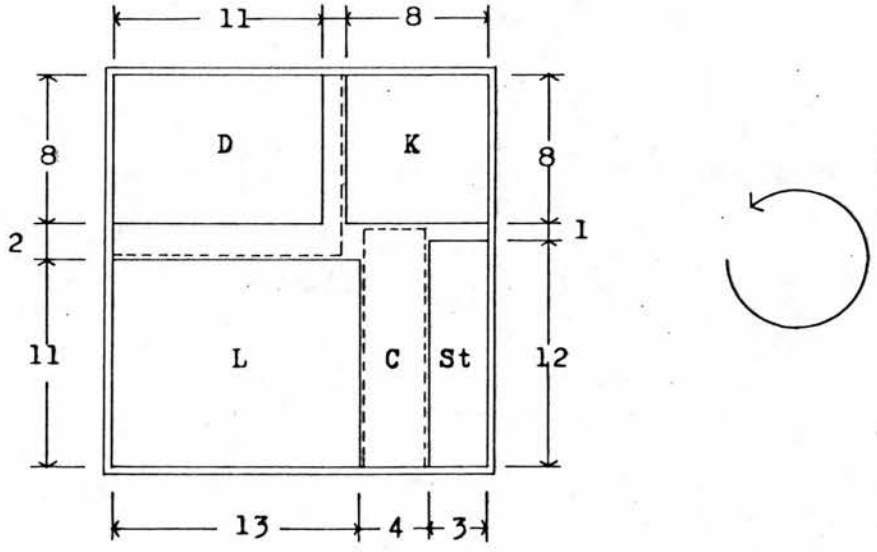


Fig. 2.12 J. C. Gray's ASP System Used by Philip Steadman for the Associative Structures Pacage(1970)

4. ADAPTABLE STRUCTURE FOR CHANGING NEEDS.

To meet the differing needs of different families and also the changing needs of each family, a regular, standard, but also adaptable, structure is required to contain the living units.

Habraken argues[1] that support structures should be developed which determine as little as possible in advance and which allow people the freedom to choose the form of their dwellings for themselves within the support structure provided.

Support structures would provide a long-lasting fabric for the city, similar to roads and services, and the dwellings within them would alter freely to meet their occupants' changing needs and preferences.

Unlike previous architectural prophets and visionaries, Habraken deliberately chose to avoid any illustrations which could give us a clear idea of the visual quality or structural principles of the environment which his approach might create.

'Supports' and 'Homes for Today and Tomorrow' were both written during the same period. Both emphasize the importance of designing for people and of producing solutions which are sufficiently adaptable to meet changing demands.

Some examples of adaptable housing plans in Europe are shown in Fig. 2.13. These allow interchangeability of rooms with regard to household size and functional segre-

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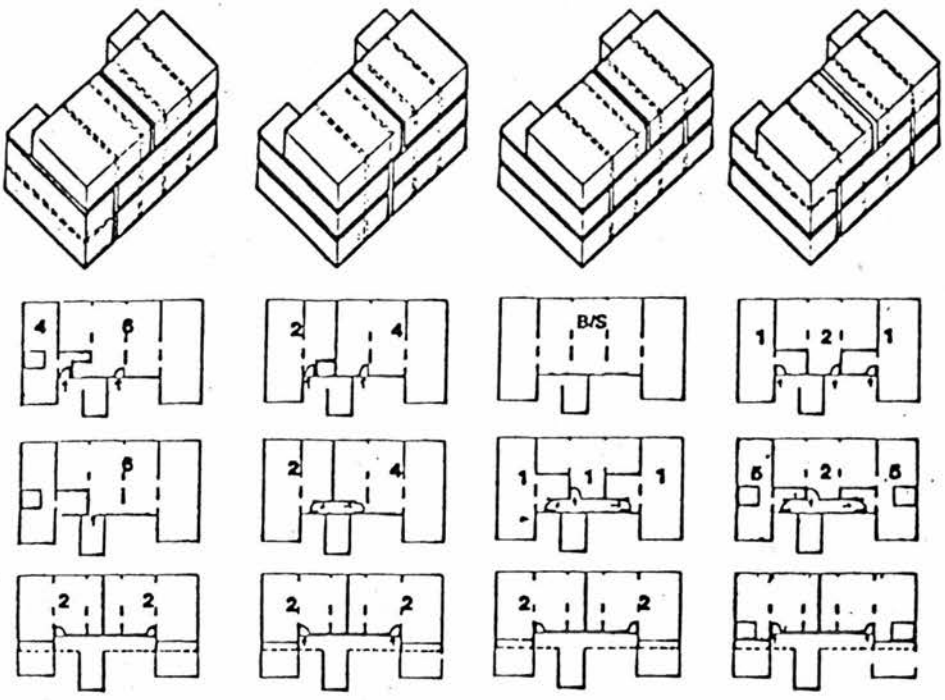
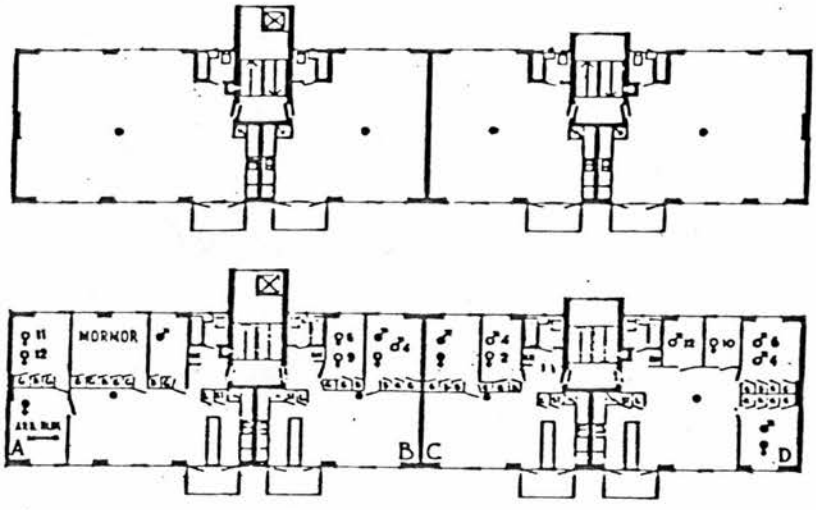
1. N. J. Habraken, 'The Support Structure', 1971.



PSSHAK Flat, Hamdi and Wilkinson and GLC.(1970)
Plans Showing Options Available on Dwelling
Size Group



Jarnbrott Göthenburg. Experimental Flat by
T & A William-Olsson in 1954

Fig. 2.13 Some Examples of Adaptable House Plans

gation. Dwelling area is not sacrificed to interchangeability and space standards do not need to drop. In the Gothenburg example, it is interesting to note that the occupants may subdivide the dwelling area at will, and may therefore determine the space standards per person for themselves.

5. OPTIMUM SHAPE OF HOUSE PLAN.

There are three aspects to be considered to obtain the optimum overall shape of rectangular house plan: the economic perimeter; the effects of thermal forces; the shape and number of rooms contained and the specified direction they must face.

5.1 The Economic Perimeter.

The shape of a building will affect not only the external cladding elements, i.e. external walls, windows and external doors, but also the internal vertical elements such as partitions and the services, both heating and plumbing. The full effect of plan shape is not always easy to determine but simple methods can be devised of relating the amount of external cladding elements to superficial floor area of the building so as to reveal the effect of different plan shapes. The relationship can be expressed as a ratio of the area of the external cladding elements to the floor area of the building, and is commonly referred to as the external cladding to floor ratio.

Reducing the building perimeter length results in a more economic shape and so the square is a better shape economically than a rectangle. A rectangle which runs north/south and has blind walls east and west is more economical than an east/west rectangle with the blind walls still east and west (the former has less external wall) and it has a smaller frontage which is cheaper to build. This plan is generally preferred in the U.K. but in Korea the

east/west plan with the wider frontage is preferred because it permits more sunlight and ventilation.

In Fig. 2.14, A, B and C represent the outlines of three Buildings of a constant height of 3 metres, each containing 225 square metres of floor area. Plan A is a compact plan with a perimeter of 60 metres; Plan B, a less compact plan with a perimeter of 74 metres; and Plan C, a plan with a perimeter of 84 metres.

This example (Table A) demonstrates that the more compact the plan can be made and the nearer it is kept to the square, the more economic it will be in terms of the area (and, therefore, the cost) of the external cladding elements.

It is necessary to consider size in relation to plan shape. Small buildings will require a higher proportion of external cladding elements to floor area than large buildings, and it will not always be possible to reduce the proportions, even though they may appear on initial examination to be high. Consider Building A, size 15 metres by 15 metres, and compare this with a similarly shaped Building D, size 150 metres by 150 metres, as in Table B.

Building A is therefore, proportionately more expensive so far as the amount of external cladding is concerned by 0.72 x 100/0.08 = 900 per cent.

From this second example it can be concluded that where the choice exists between enclosing an area in one large building or in two or more smaller buildings, it will almost certainly be more economical to choose to provide the accommo-

Table A

Example	*Area of External Cladding Elements, m^2*	*Floor Area, m^2*	*Ratio of External Cladding Elements to Floor Area*	*Base Plan A 100*
Plan A	180	225	0·80	100
Plan B	222	225	0·99	124
Plan C	252	225	1·12	140

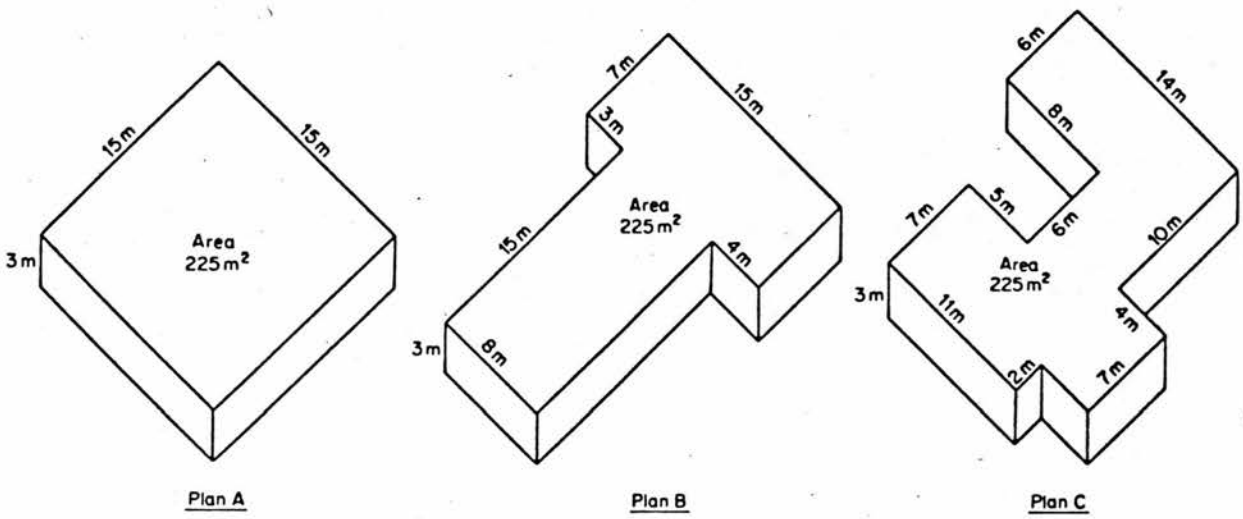


Table B

Example	*Area of External Cladding Elements, m^2*	*Floor Area, m^2*	*Ratio of External Cladding Elements to Floor Area*	*Base Plan A 100*
Plan A	180	225	0·8	100
Plan D	1,800	22,500	0·08	10

Fig. 2.14 Comparison of Different Shapes of Buildings for Economics of Planning(Butler 1973)

dation in the larger building. If only external cladding elements are considered, this would be absolutely true, but other factors such as servicing and lighting requirements must serve to qualify this conclusion. It is also worth noting that an external corner column will only be carrying a quarter of a bay and will be eccentrically loaded, this being less economical than an internal column. It follows, therefore, that a rectangular plan shape with only four external corner columns will be more economical than an irregular plan shape with numerous corner columns.

5.2 Impact of External Thermal Forces on Building.

Heat loss and gain depend upon construction (i.e. insulation, window areas) as well as upon geometry. The 'optimum' thermal form can be achieved with a wide range of building shapes by modifying the amount of insulation and careful design of window areas, positions and solar protection.

A case study of the four locations chosen as typical of the main U.S. climate zones is presented[1]; these areas represent cool, temperate, hot-arid, and hot-humid environments. The coldest and the warmest days were chosen in each region as indices for winter and summer conditions. The radiation effect on the various sides of a building can be expressed in Btu/ft^2/day.[2] It appears that, in the upper latitudes, the south side of a building receives nearly twice as much radiation in the winter as in the summer.

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1. V. Olgyay, Design with Climate, 1963. The data in this study is in imperial units; since the purpose is to discern relative effects, no conversion has been made.

2. 1 W/m^{2}degC = 0.1761 Btu/ft^{2}h degF.

The effect is even more pronounced at the lower latitudes, where the ratio is about one to four. Also in the upper latitudes, the east and west sides receive about $2\frac{1}{2}$ times more radiation in summer than in winter. This ratio is not as large in the lower latitudes; but it is noteworthy that in summer there these sides receive two to three times as much radiation as the south elevation. On the west side high temperature impacts are augmented by the afternoon radiation effects. In all latitudes the north side receives only a small amount of radiation, and this comes mainly in the summer. But in low latitudes the north side receives nearly twice the impact of the south side in the summer.

It can be taken as a rule that the optimum shape is that which loses the minimum amount of heat in winter, and accepts the least amount of heat gain in summer. It is widely believed that a square building is best for preserving the heat in winter and remaining cool in summer. This conviction is based on the fact that a square building combines the largest practical volume with the smallest outside surface.

When an inverse relationship exists between the thermal impacts and the sizes of the sides of the structure, the optimum form represents the thermal forces in equilibrium.

To investigate the shaping effect of the thermal environment, Olgyay chose a house type and placed this hypothetically in four regional climates which had been analysed. The selected house consisted of traditional insulated frame

construction (U = 0.13 Btu/ft^{2}h°F), with 40% glass (single pane) on the south side, and with 20% glass surfaces on all other sides. Although all the conclusions apply directly to this specific type of house, other types will behave more or less similarly (see Table 2.3 and Fig. 2.14). Very well insulated houses, or building with shading devices on the south side will show even more strongly the deformation effects described. Conversely, buildings with relatively small window openings, or in full shade, will show less need for elongation.

As a reference for comparison, a 1000 square foot house with equal sides was computed first. Only the heat impacts through the four sides were calculated, as the impact through a horizontal roof remains constant regardless of the form. The hour-by-hour calculated heat flows were added to make a total daily (24-hour) summation. The square house showed the incoming and outgoing heat amounts at the different locations illustrated in Table 2.3(a). Those results of the house with the square plan now can be compared with houses of the same construction, characteristics, and same square-foot area, but with different forms; some elongated in an east-west, some in a north-south direction. In Table 2.3(b), the left-hand column refers to the east-west versus north-south relationship of the sides of the building.

To define the most desirable form of a house in the given environment the criterion of 'optimum shape' was applied. However, to leave a certain latitude wherein the

(a)

	Total Btu impact/day	
	Winter	Summer
Minneapolis	−352.400	196.600
New York	−194.300	190.300
Phoenix	42.500	338.500
Miami	171.800	231.000

(b)

TEMPERATE REGION
(New York - N.J. Area)

Ratio	Total Btu impact/day Winter	Summer
5:1	−300.900	296.300
4:1	−275.300	272.000
3:1	−247.900	245.600
2:1	−221.100	217.300
1.5:1	−207.000	203.400
1:1	−194.300	190.300
1:1.5	−189.000	184.700
1:2	−190.700	185.500
1:3	−199.600	193.300
1:4	−211.000	203.600
1:5	−222.900	214.500

HOT ARID REGION
(Phoenix, Ariz.)

Ratio	Total Btu impact/day Winter	Summer
5:1	−15.400	489.600
4:1	− 7.600	452.400
3:1	2.600	413.100
2:1	16.700	372.200
1.5:1	26.800	353.100
1:1	42.500	338.100
1:1.5	59.900	337.200
1:2	73.300	344.800
1:3	95.700	367.900
1:4	113.900	394.000
1:5	129.800	419.700

COOL REGION
(Minneapolis, Minn.)

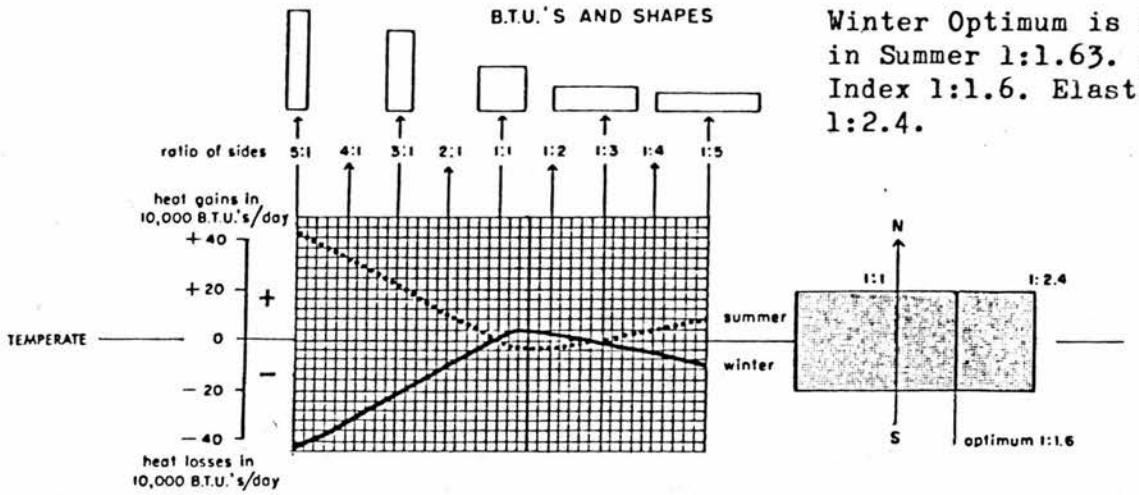
Ratio	Total Btu impact/day Winter	Summer
5:1	−491.300	295.500
4:1	−455.600	272.500
3:1	−418.000	247.400
2:1	−380.200	220.800
1.5:1	−363.600	207.700
1:1	−352.400	196.600
1:1.5	−355.500	193.300
1:2	−366.800	196.600
1:3	−395.200	206.400
1:4	−425.500	220.600
1:5	−455.400	235.000

HOT HUMID REGION
(Miami Fla.)

Ratio	Total Btu impact/day Winter	Summer
5:1	160.100	364.400
4:1	155.800	334.200
3:1	152.900	301.100
2:1	154.100	265.900
1.5:1	158.900	248.200
1:1	171.800	231.000
1:1.5	191.300	223.200
1:2	209.500	223.400
1:3	243.400	231.500
1:4	273.800	243.400
1:5	301.300	256.000

Table 2.3 Ratio of the Side-By-Side and the Total Btu Impact /Day (Olgyay 1963)

(a) Building Shape in New York (Olgyay 1963)



Winter Optimum is 1:1.56, in Summer 1:1.63. Adopted Index 1:1.6. Elasticity 1:2.4.

(b) Comparing the Climograph with Seoul and New York

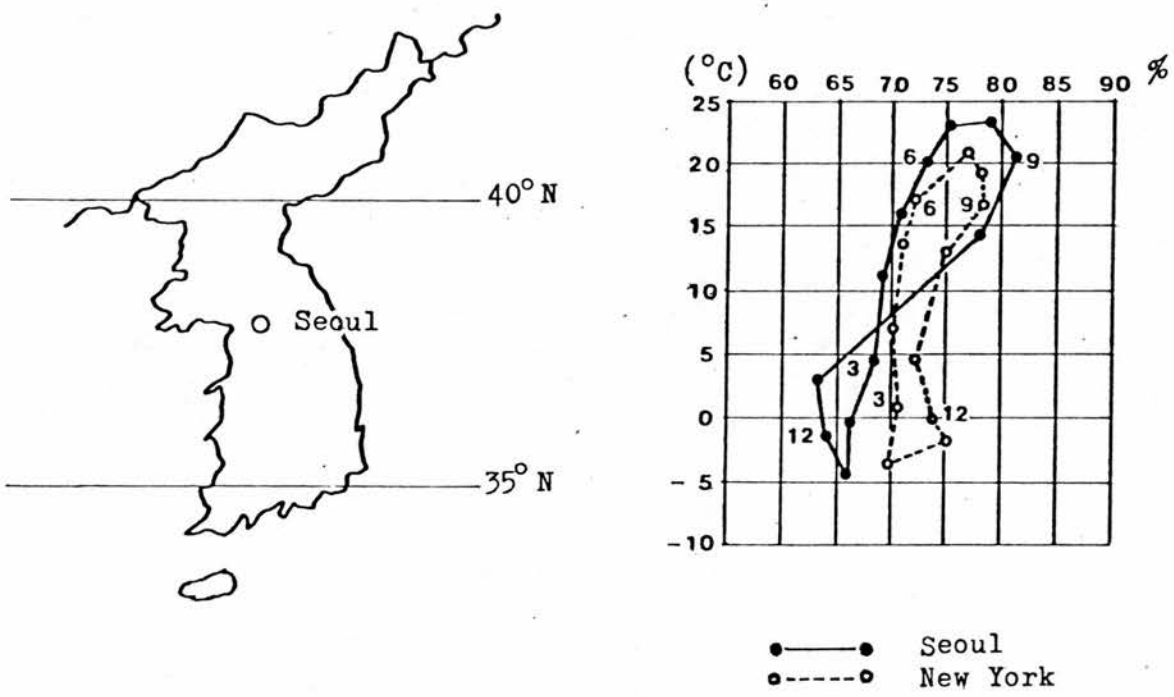


Fig. 2.15 Building Shape and Comparing the Climograaph with Seoul and New York

proportions of a plan can be considered as generally good, the criterion of 'elasticity' was adopted. The upper limit of variation from the optimum was arbitrarily defined here as the elongated shape that is subjected to the same heat impacts as a square form. These criteria applied to the given locations result in the following conclusions as shown in the Fig. 2.15(a).

From the above the following observations can be drawn:

i) The square house is not the optimum form in any location.

ii) All shapes elongated on the north-south axis work both in winter and summer with less efficiency than the square one.

iii) The optimum lies in every case in a form elongated somewhere along the east-west direction.

These criteria apply equally to New York and Seoul as both are on the same latitude and also have a similar climate as shown in Fig. 2.15(b) which compares the climograph with New York and Seoul.

So it may be concluded that the optimum shape of house plan for Korea (without considering any shadow which may be cast) is 1:1.6 within the range 1:1 to 1:2.4.

6. SPACE AND FORM OF KOREAN HOUSE.

6.1 Orientation of Housing.

Korean houses have a standard orientation which follows a traditional pattern. Believing that evil comes from the north, Koreans have always preferred to approach a house from any direction other than north. A more rational explanation is that buildings look more attractive with the sun shining on them. Also people prefer to have some sort of defensive structure behind them. If natural features such as hills do not exist they try to create a defence in the form of a fence. Failing this, a blank north house wall is relied on to give an illusion of security. For example houses are built well back in the plot to fulfil this need for a protective rear fence. This creates a front yard which catches the sun. It opens onto the access road because the entrance gate is also to the south so that the house can be approached from that direction. These relationships are illustrated in Fig. 2.16(a).

6.2 Traditional Type of Houses.

Two different traditional plans have evolved for Korean houses. In the north, the people favour a square, dual aspect, plan which conserves heat as the warm 'ondol'[1] rooms are close together. This is because people in the north cannot depend on sunlight to heat their houses and have to seek an artificial method of heating. However, in the south, the preference is for a single aspect, south

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1. See Appendix H,(pp. 185-186).

facing plan. These two plans, sometimes modified, appear side by side in central Korea. Most Koreans live in a single aspect plan house which can be extended if required. If the house is added to, the plan could be altered so that it becomes L, U, or U in shape. If this is still insufficient, similar buildings can be linked to form a single large house shown in left part of Fig. 2.16(c).

All of these plans still adhere to the basic idea of orientation as far as possible. However, single aspect plans are uneconomic because of the large perimeter wall, and access to different rooms is via the yard as there are no corridors. Therefore, this plan has become less popular than the rectangular dual aspect plan which is cheaper to build and heat. Traditional and modern forms are further illustrated in Fig. 2.17. This modern house also follows the traditional orientation (mainly facing south) and often retains another feature of traditional houses where rooms connected directly with the courtyard and to each other without corridors.

6.3 Space and Form of Modernization.

There are two types of floor - the Ondol and Dechung[1] (wooden floor), the former is for the cold weather and the latter is for the mild and hot climate. People usually prefer to eat, sleep and relax in Ondol rooms although in recent times there has been a degree of westernization and some people now only use Ondol rooms as bedrooms. However, bedrooms in Korea are not just used for sleeping and tend

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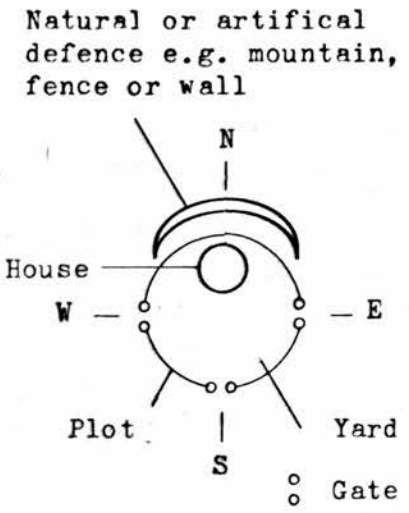
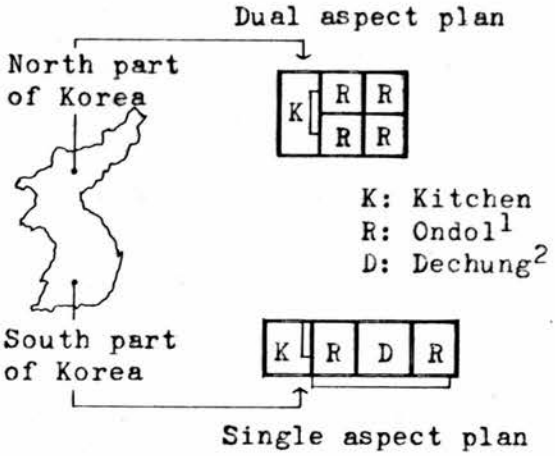
1. See Appendix H, (p. 185).

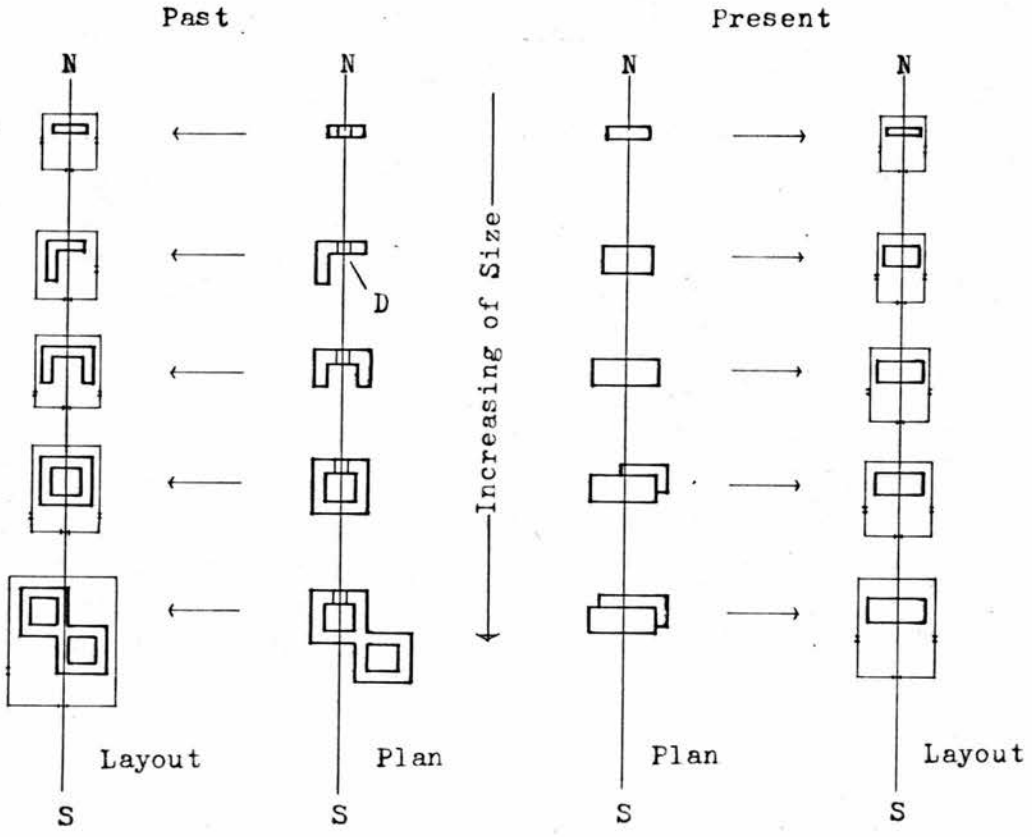
(a) Orientation of Housing



(b) Two Different Types of Korean House Plan



(c) House Plans and Layout



Shifting shapes of the single aspect plan

Simple rectangular shapes of the dual aspect plan, approaching gate from south, east or west

Fig. 2.16 Space and Form of Korean House: Modernization of Shape of Plan and Layout

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1 & 2. See Appendix H (pp. 185-186)
3. See Appendix I (p. 188)

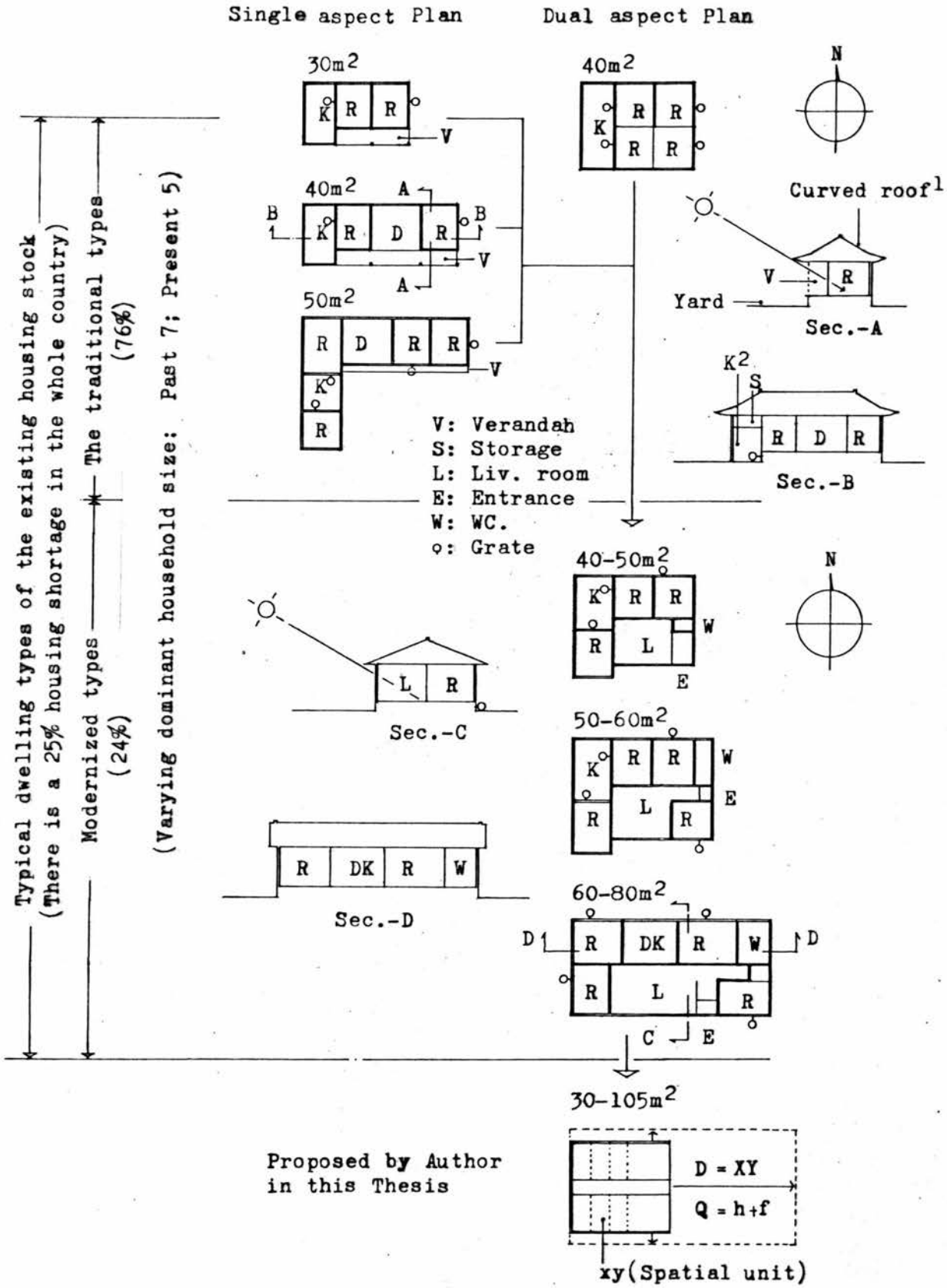


Fig. 2.17 Space and Form of Korean House: Traditional and Modern

1. See Appendix I (p. 188)
2. See Appendix H (p. 186)

to be multi-purpose. This is typical of Korean houses as a whole where rooms do not have specific purposes as they do in the west (e.g. dining room). Another difference is that Western furniture, such as chair, bed, etc. does not correspond to Korean furniture. This results in a better use of space and so less living space is required in Korea than in the west.

On the other hand, with the introduction of western furniture and culture, people now require more space to accommodate it. At present there is a great variety in the dwelling areas of different people, with 75% still living in traditional houses and the rest in varying sizes of modern houses shown in Fig. 2.17. To eradicate this inconsistency, designers and planners must aim at a general upgrading and standardization of present dwelling areas.

7. SUMMARY AND CONCLUSIONS.

Some theoretical and methodological aspects which underlie the establishment of a quantitative area/dimension relationship have been investigated. Typically in rectangular geometrical arrangements, problems arise in architectural design in the fitting or packing together of rooms into a plan within a certain range of shape and dimension.

These problems are further complicated by the need to satisfy, within the geometrical arrangement, certain required topological relationships between rooms. Cultural values also influence arrangements.

It is possible to think of the overall plan outline - the shape of a building's perimeter - as being derived in two distinct ways. Either the building is designed from the inside outwards: rooms are assembled according to some criteria, so that the final building shape is merely the end result of this process. Or else the external form of the building is determined first on quite different grounds, and then, like an empty container, it is filled up with rooms.

It is necessary to consider systematic generation of the minimum space standard house plans in conjunction with the above two approaches.

If the whole plan is broken down into components, it will be seenthat they are:

i) The whole plot within its marked boundary.
ii) The perimeter house wall or frame plan.
iii) The room units.
iv) The fittings, the furniture units and 'elbow room' (or activity space).

At each breakdown stage the possibility of variety increases but if these components are considered in reverse, it can be seen that each stage controls the one before it. Even the arrangement of furniture is controlled by the location of window and door which itself may be decided by the situation of the house and the amount of sun it is to receive depending on the proposed optimum shape. They must allow maximum freedom of arrangement and so the room plan must restrict this as little as possible. Individuals may also have different ideas regarding the topological arrangement of their rooms. This will affect the resulting configuration of the house frame and its shape may influence the exterior plot boundary. The importance of this will depend on different countries' regulations concerning distance between houses and plot size.

So the required house plan must be flexible enough to cover those requirements and yet still adhere to any existing government standards.

From these studies there has emerged an area requiring further development and this is summarized as follows:

i) A systematic variation of the minimum room sizes and dimensions should be investigated to determine the most economic house plan, for each household size, which still allows the individual to select the arrangement he desires.

ii) The room arrangement in a house plan should be as flexible as possible to satisfy any topological requirement of the occupant.

iii) The determination of minimum dwelling sizes

should take into account possible fluctuation in household size and varying degrees of functional segregation.

iv) In deriving the optimum shape of the house plan (the perimeter wall ratio), important factors include the consequent effect on costs and thermal efficiency.

v) The plot shape and relation of the house to the plot boundary should also be considered.

To satisfy all these requirements a total design structure for housing form is needed.

CHAPTER III

COMPREHENSIVE OVERALL FRAMEWORK

1. INTRODUCTION.
2. BASIC FORMULATION AND EVALUATION FACTORS.
3. SPATIAL UNIT AND AVAILABLE SIZES OF THE COMPONENT.
4. COMPREHENSIVE OVERALL FRAMEWORK.
5. SUMMARY AND CONCLUSIONS.

1. INTRODUCTION.

As stated at the conclusion of Chapter II, a comprehensive overall framework, satisfying the necessary criteria, is required.

This Chapter describes the formulation of such a framework, which builds up in scale from fittings and furniture to plot size, and allows for the precise definition and interpretation of the relationships between different components in house planning, subject to a specific set of criteria relevant to space standards.

2. BASIC FORMULATION AND EVALUATION FACTORS.

At different scales in housing design the geometrical form is determined by appropriate sets of design criteria.

Fig. 3.1 expresses the relationship between these three values: Form (X), Criteria (Y) and Scale (Z). To make practical use of this conceptual framework it is necessary to adopt a systematic approach introducing certain general principles.

Form (X), Criteria (Y) and Scale (Z) can be divided into three constitutional elements:

Form (X) = Shape (X_1)/Size (X_2)/Attitude (X_3)
Criteria (Y) = Degree of functional segregation (Y_1)/culturally determined requirements for inter-personal space (Y_2) household structure of inhabitants (Y_3).
Scale (Z) = Horizontal scale (Z_1)/Vertical scale (Z_2)/ Density of habitation (Z_3).

as shown in Fig. 3.1(a), (b), (c).

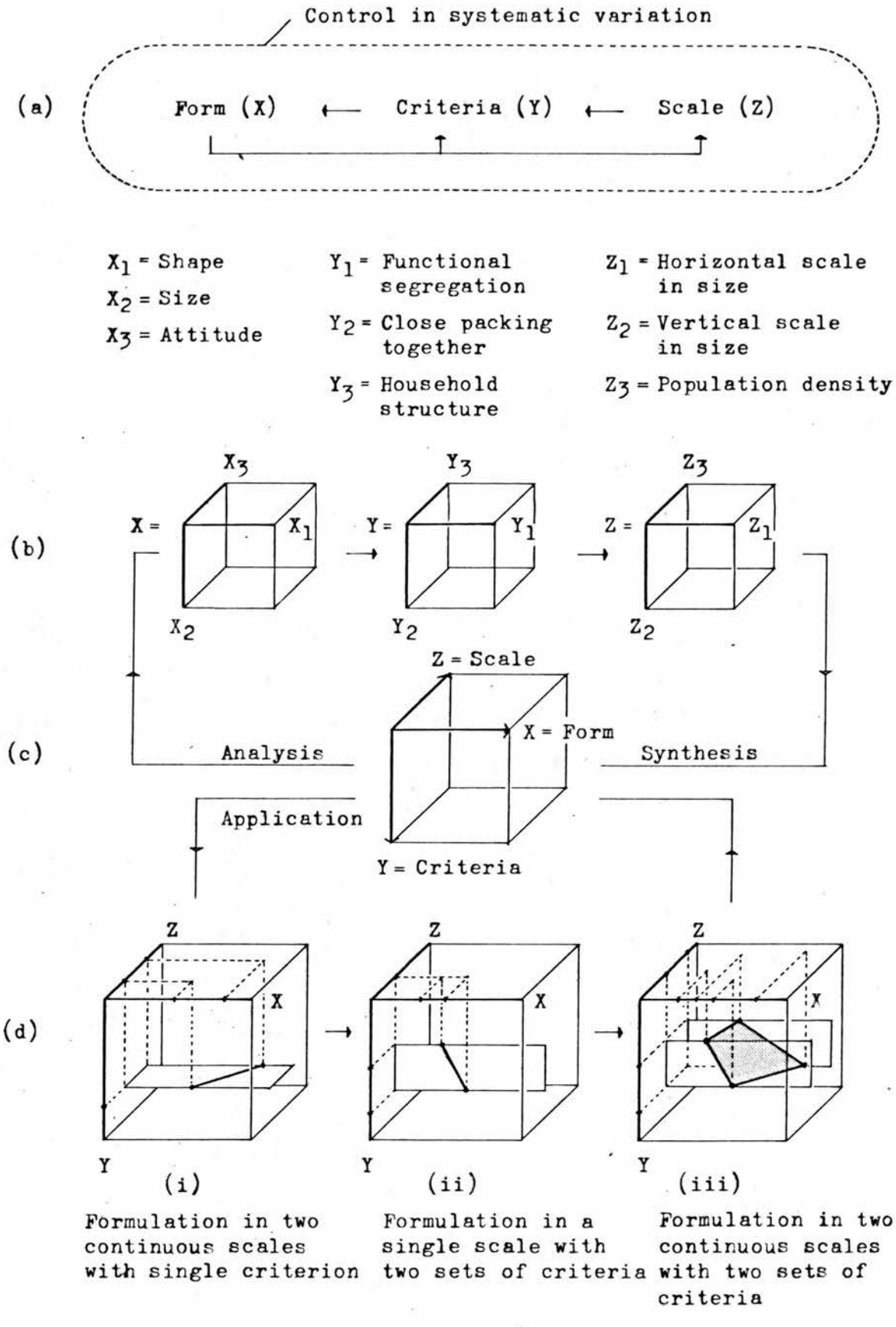


Fig. 3.1 Basic Relationship between Scale, Criteria and Form

Some variations in the criteria of form and scale may be considered in practice as

1) Formulation in two continuous scales with a single criterion, e.g. formulation of house plan and building layout with single criterion - the U.K. norm.

2) Formulation in single scale with two sets of criteria, e.g. formulation of room designs with two sets of criteria based on norms of the U.K. and Korea.

3) Formulation in two continuous scales with two sets of criteria, e.g. formulation of room designs and house plans with two sets of criteria based on the norms of the U.K. and Korea.

These are shown in Fig. 3.1(d).

3. SPATIAL UNIT AND AVAILABLE SIZES OF THE COMPONENTS.

3.1 Spatial Unit Ratio Over Rooms.

To facilitate the interchanging of rooms, the use of a spatial unit is recommended. This should be rectangular and have a simple ratio over the rooms (e.g. 1:1.5 or 1:2 ..).

Fig. 3.2 compares the space standards of a number of different countries; the first column shows the official recommended sizes for kitchen, dining-room, living-room and two or three bedrooms (for 2 parents and 1 or 2 children).

By inspection, simple ratios of the sizes of rooms may be identified, giving spatial unit ratios as follows:

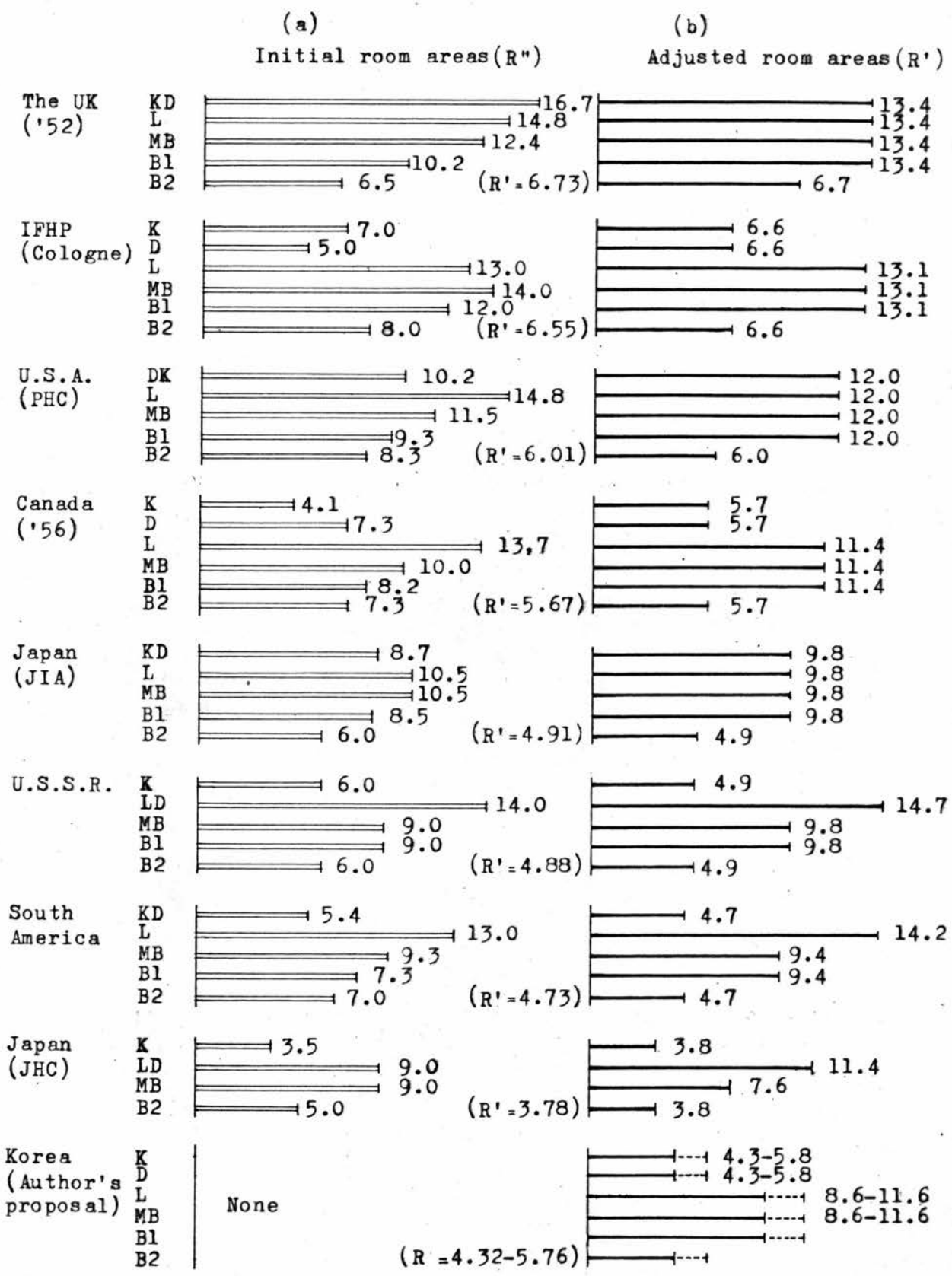
Living room (L)	2	Parent bedroom (B-1)	2
Dining/Kitchen (DK)	2	2-Children's bedroom (B-2)	2
Dining Room (D)	1	1-Child's bedroom (B-3)	1
Kitchen (K)	1		

The total area $(\Sigma R')$ of each room divided by the total number of units (Σu) gives the spatial unit area $(R' = \frac{\Sigma R''}{\Sigma u})$.

In general, poor countries have a smaller spatial unit area and the wealthier countries have larger spatial unit areas. This can be seen as a general indicator of rising/falling living standards. For example in : South America R' is 4.73, however in the U.K. R' is 6.73.

Column (b) is derived from the simple ratio and the unit area given in (a), and in column (b) the proposed adjusted sizes for these countries' space standards are presented. They are more regular in size, allowing more interchangeability than is possible at present. These proposed sizes would give a simpler ratio over the rooms.

There is less difference between the real standards of



KD:Kitchen/dining(u=2) L:Living room(u=2) D:Dining room(u=1) MB: Master bed room(u=2) B1:Children's bed room(u=2) B2:Child's bed room(u=1) $R'=\frac{\Sigma R''}{\Sigma u}$ R=Adjusted room area for spatial unit

Fig. 3.2 Comparison of the Space Standards of Certain Countries and Adjustment for Simple Ratio Over the Rooms

Source: Fig. 2.8 (p. 22)

the lower-scale countries and the proposed standards than the real standards of the upper scale countries and the standards suggested for them in this thesis.

Where the adjusted sizes are smaller than the real sizes, they must be checked to ensure that minimum requirements are still met - e.g. furniture and fittings can still be accommodated.

3.2 Available Sizes of the Components (i.e. rooms, units, etc.)

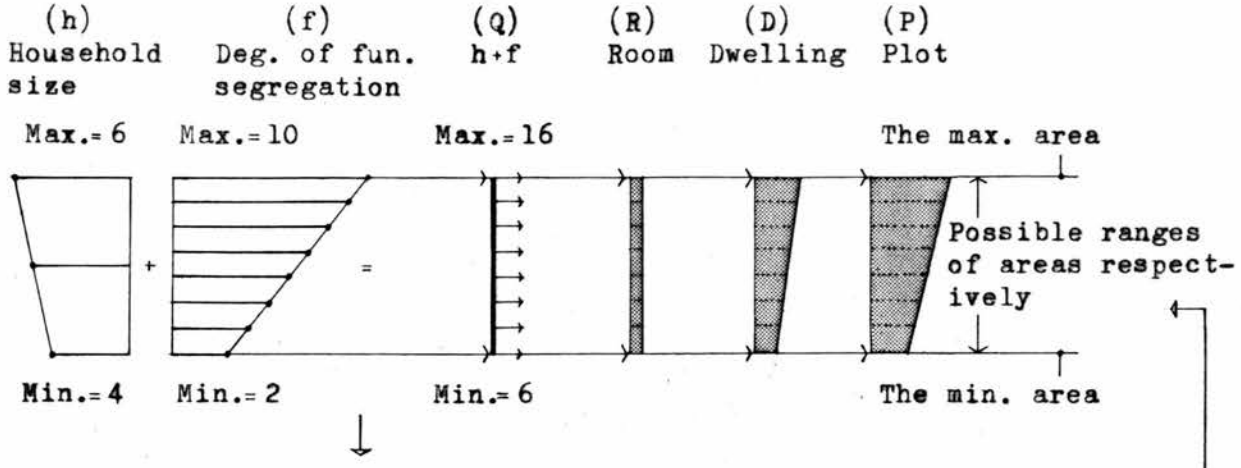
The size and number of rooms required for the formulation of the house plan mainly depend on the household size, degree of functional segregation and culturally determined requirements for inter-personal space.

The sizes and the number of rooms produce a limited range of house sizes. House size, location and dimensions of neighbouring buildings (allowing for possible developments) may determine plot sizes.

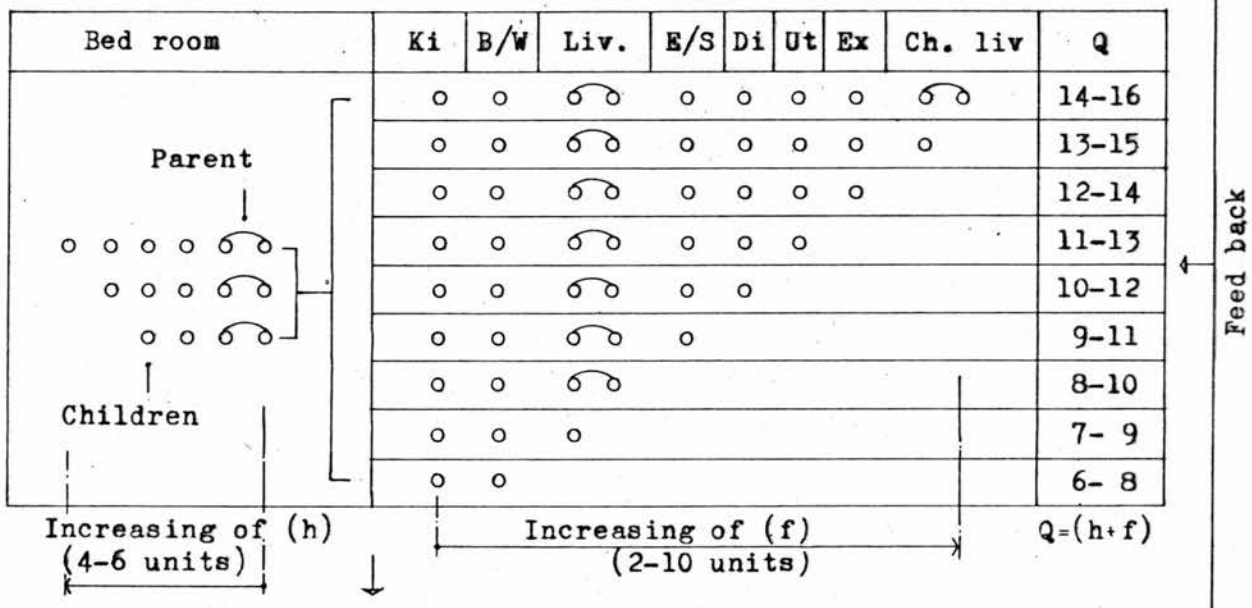
Fig. 3.3(b) shows the ratio of number of spatial units to size of family and degree of functional segregation, allowing one bedroom unit to each member of the family (except for the living room which consists of two units and the optional children's living room which also has two). Each of the other rooms (kitchen, W.C./bathroom, entrance/storage, dining-room, utility and extra room) is one spatial unit.

Diagram Fig. 3.3(a) shows how household size (h) is related to functional segregation (f). The number of spatial units required (Q) is determined by h and f, and in turn, it

(a) The Possible Maximum and Minimum Area of Room/Dwelling/Plot Regarding Q



(b) The Possible Number of Spatial Units Corresponding to (h) and (f)



(c) Development of Domestic Life and House Patterns

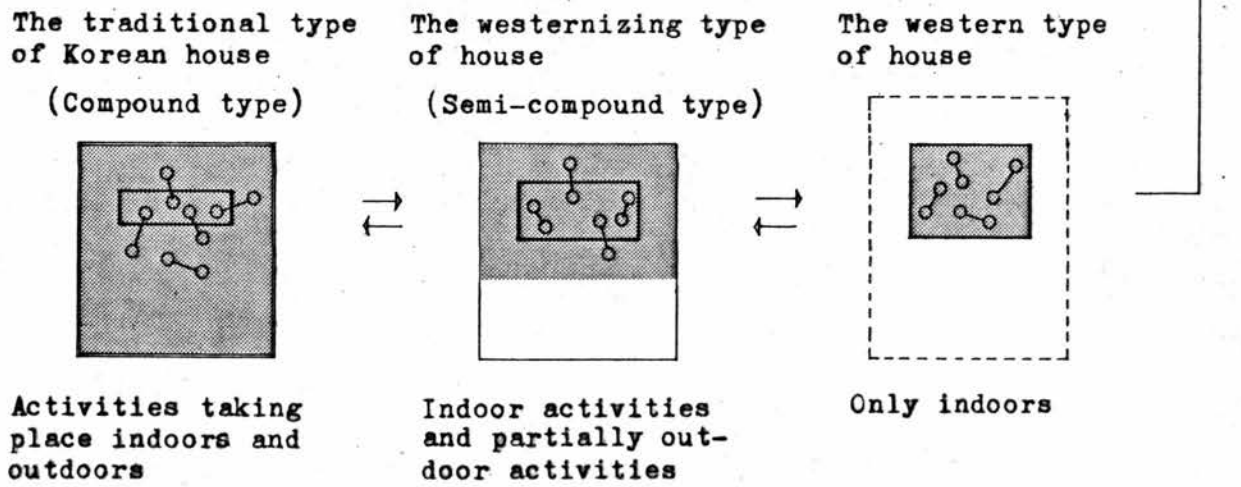


Fig. 3.3 Possible Minimum and Maximum Areas of Each Scale, Spatial Unit and Variation of House Patterns

affects room size (R). These control overall dwelling size (D) and all of these factors may ultimately influence plot size (P).

In Diagram (b), (h) and (f) again determine (Q). Each member of the household is allotted one spatial bedroom unit (children are regarded as adults for the purposes of this investigation). Assuming a household has four to six members, the diagram also shows the minimum and maximum number of rooms (spatial units) required: the very smallest size of house for 4 persons (Q = 6) i.e. 4 bedroom units plus one spatial unit for the kitchen and W.C./bathroom respectively, the largest size of house for 6 persons (Q = 11) i.e. 6 bedroom units plus total units of all the rooms is illustrated on the right hand side of the diagram.

In the smaller house, the lack of space results in some activities being carried on outside, using the external space as an extension of the internal as in the 'compound house'. However in larger houses this is not necessary and activities are mainly internal as in the western type of house. These alternatives are illustrated in Fig. 3.3(c). The first compound is the traditional type of Korean house where activities are equally divided between indoor and outdoor, and outside is an extension of inside. The second one is the 'westernizing' type (semi-compound) which is midway between the first and third. This last type (western) is very rigid in that most activities are indoors and there is a very definite boundary between inside and outside.

Currently, Korean houses are becoming more westernized as standards improve or the degree of functional segrega-

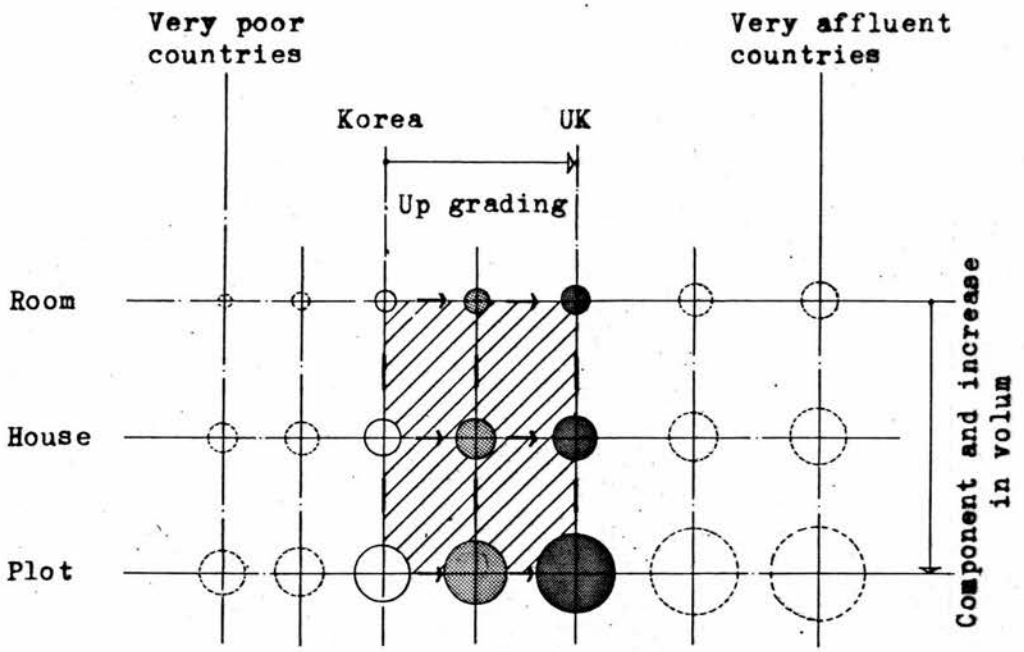


Fig. 3.4 Systematic Relationship between Room/House/Plot

tion increases, and they become more universal. This tendency can be seen in Fig. 3.4 which shows the comparative upgrading of various countries' standards. The horizontal lines represent the improved living standards and the vertical lines are the components. The figure also represents a section of a larger, extended diagram showing relative living standards of both very poor and very affluent countries. The shaded part of the diagram is the area of study in this thesis, i.e. the relationship, within a framework, in space standard of fitting and activity/room/house/plot.

4. COMPREHENSIVE OVERALL FRAMEWORK.

The comprehensive overall framework suggested here is represented in three vertical lines, relating Form, in the centre, to Scale and relevant Criteria on each side, as shown in Fig. 3.5. Fig. 3.6 gives a detailed explanation of the symbols used in Fig. 3.5.

The norms of the U.K. and Korea are offered as the criteria, and the five steps of the scale are set up as:

S_1 : Fittings
S_2 : Individual rooms
S_3 : Adjustments for rooms
S_4 : The house plan
S_5 : The layout of the plot

The form developed at any specific scale, through the use of the framework, may be continually tested by feedback introducing criteria at smaller scales. This process, progressing through increasing scales, involves the packing together of components within an overall rectangular shape.

$S_1 \dashrightarrow S_2$ Process

The determination of the available range of shapes and the minimum room area (x.y) is dependent on;

i) Shape/size/attitude of S_1 components, (α, β, γ and ε). (α = activity space, β = fittings space, γ = storage space ε = circulation space).

ii) Guide line of a topological relationship between S_1 components, (Gr).

iii) Given modular dimension on a grid plan, (MC).

iv) Arrangement of S_1 components set up in a variety of shapes, (Tr_1, Tr_2 ···).

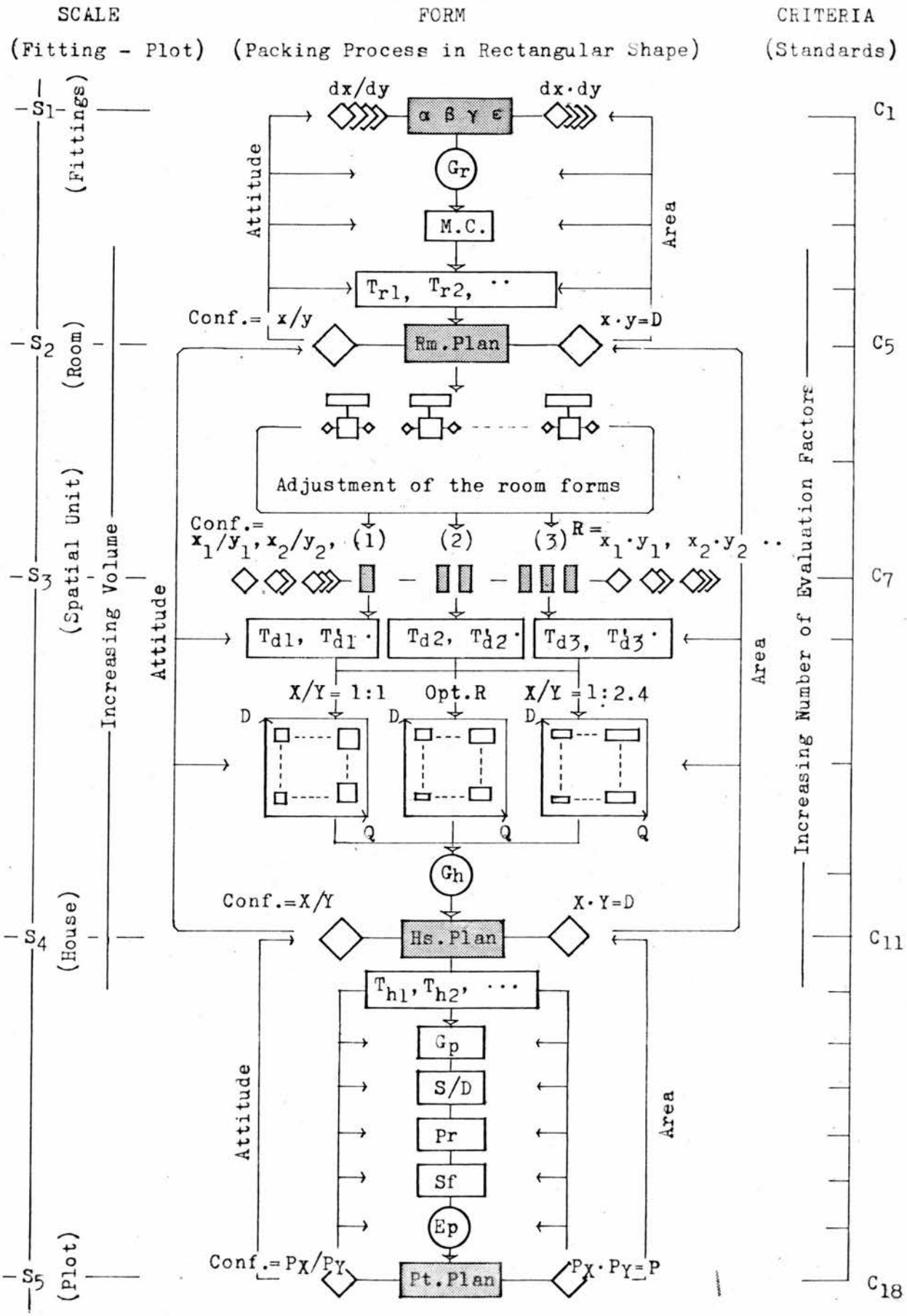


Fig 3.5 Total Flow System for the Generation of the Housing Plans (Diagram)

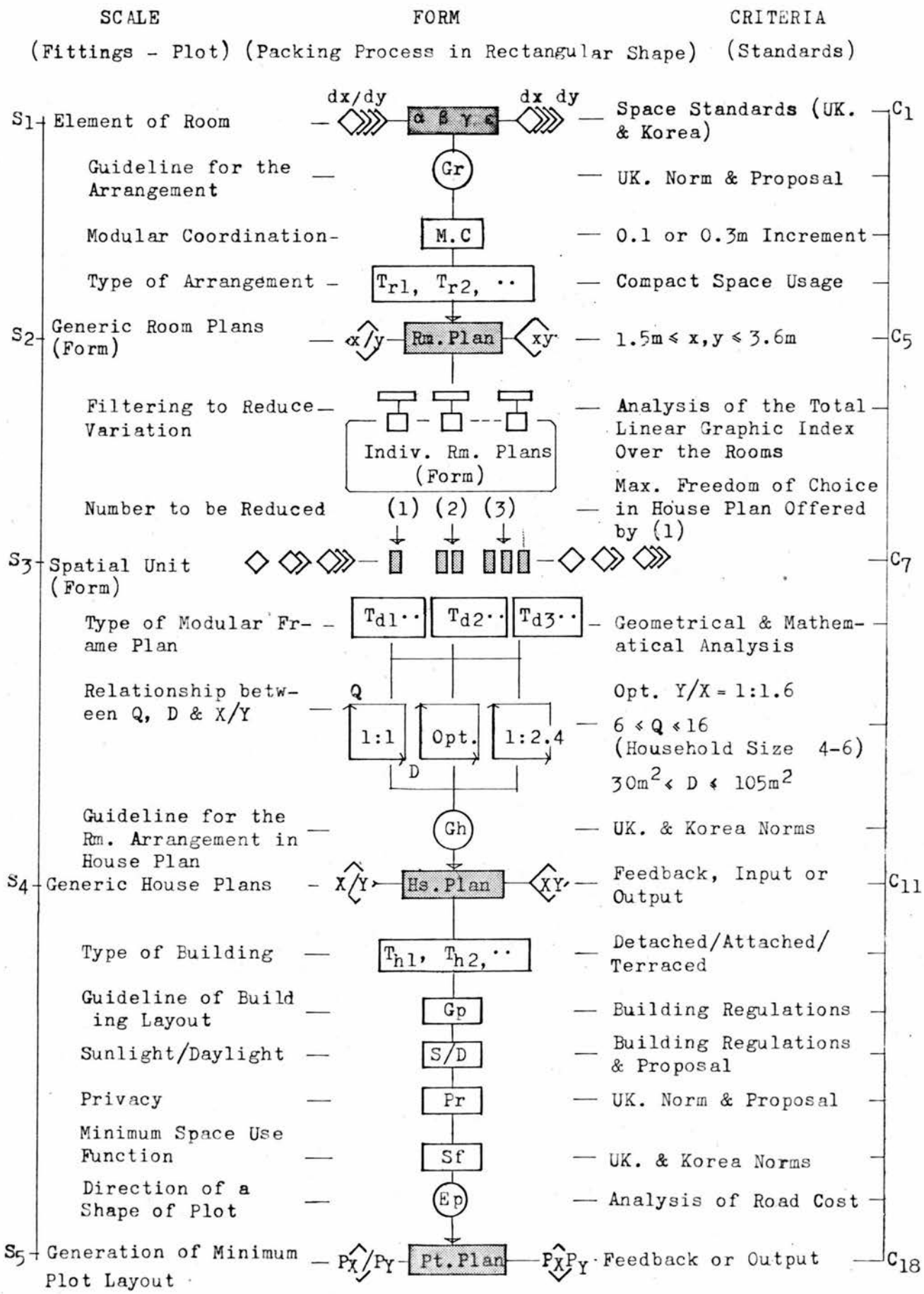


Fig 3.6 Total Flow System for the Generation of the Housing Plans (Explanation)

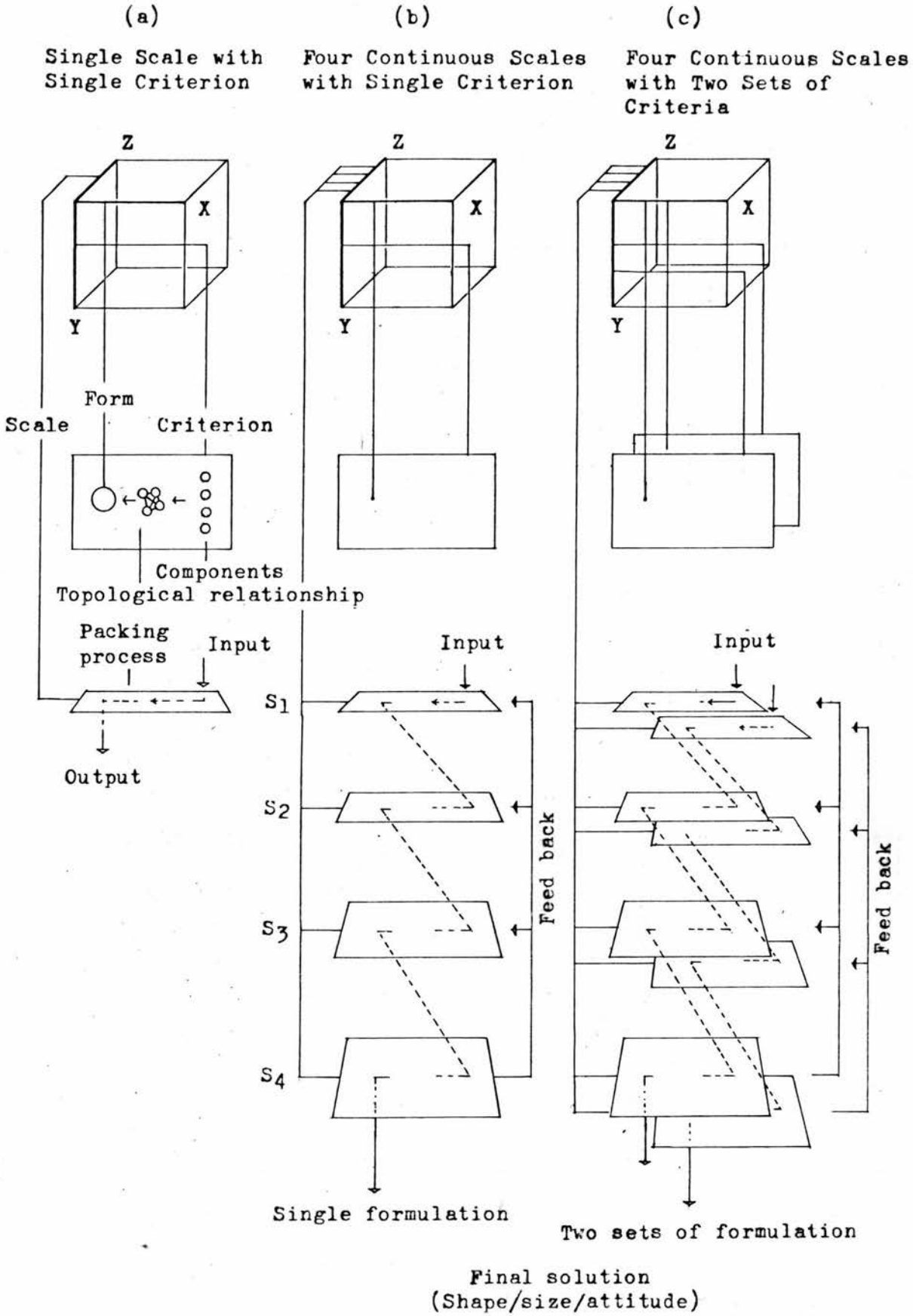


Fig. 3.7 Process of Packing Together with the Component in Each Scale

$S_2 \dashrightarrow S_3$ Process

i) The variety of room size/shape/dimension necessary must be considered with a view to limiting their numbers as far as possible.

ii) Although interchangeable rooms are required more than one size and shape may be needed to cater for this, (R).

iii) It is imperative to try and keep them alike as much as possible to eliminate space wastage.

$S_3 \dashrightarrow S_4$ Process

i) To satisfy the formulation, the optimum overall shape ($^X/_Y$) must be considered in terms of: building cost of an external and internal wall length per floor area; optimum thermal form within the range given previously.

ii) Within those remaining constants, a number of available regular frame plans (Td_1, Td_2 $\cdots$) can be selected according to the desired overall house plan area (D) and the number of rooms which the different household sizes require together with the degree of functional segregation, (Q), needed.

iii) By applying dimensional constants to the topological analysis (which reflects practical limitations and functional performance) plus user's preference, social customs, life style and so on as guideline (G_h), a certain number of house plans can be created with appropriate room arrangements.

$S_4 \dashrightarrow S_5$ Process

Some examples of dwelling layout (T_{p1}, T_{p2}, $\cdots$) are considered i.e. detached, semi-detached and terraced. The determination of the available

range of shape and the minimum plot area (P_X . P_Y) is dependent on;

i) Privacy.

ii) Directional orientation of the building.
iii) Height and distance from neighbouring houses,
iv) Sunlight and daylight.
v) The minimum required area for outdoor activities.
vi) The location of access, whether on frontage or on side.

The result of these considerations (P_X . P_Y and P_X/P_Y) should be fed back into the house plan ($X \cdot Y$ and X/Y) for final adjustment to produce a number of house plans with appropriate room arrangements as mentioned above.

This process is described graphically in Fig. 3.7, the principal operation of which is explained more fully in Fig. 3.1. Similarly, Fig. 3.7 details the main aspects at each scale of Fig. 3.5.

5. SUMMARY AND CONCLUSIONS.

Chapter II demonstrated the need for a total design structure which would satisfy all the criteria investigated. To illustrate this conclusion a diagram of the total flow system, incorporating the concept of the spatial unit for the generation of a house plan, was developed. It shows the correlation of all the components. Each scale has an appropriate size and dimension which produce a constant configuration. The four shaded areas represent the plot plan and its components.

The diagram also shows the possibility of constant feedback of each stage to those before it and relates them to the scales on the left and right. The left scale starts with the size of fittings in the packing process and works through size of rooms, spatial unit, house plan and plot plan. The scale on the right shows the evaluation factors, i.e. the criteria which govern the final solution.

When all those factors are operated simultaneously, they control each other and eliminate any impractical solutions, leaving only the required overall framework.

This framework has been designed for use by practically every country in the world and will never be obsolescent as it is flexible enough to cater for any variation in culture or living standards.

CHAPTER IV

FORMULATION OF THE MODULAR SPATIAL FRAME PLAN

1. INTRODUCTION.
2. MODULAR SPATIAL FRAME PLAN.
3. MODIFICATION OF AREA AND DIMENSIONS AVAILABLE IN REGULAR FRAME PLAN.
4. SUMMARY AND CONCLUSIONS.

1. INTRODUCTION.

This chapter develops the basic points in the determination of a flexible regular spatial frame plan. The first section below deals with such factors as perimeter wall/floor area ratio and area needed for circulation, in evaluating rectangular forms of different proportions. The study is restricted to dual aspect plans with regard to the maximum interchangeability of rooms. This question of plan flexibility is explored further in the next section where individual room dimensions are consdered in relation to specific types of house plan, optimum overall configuration, dwelling size and room depth.

2. MODULAR SPATIAL FRAME PLAN.

A modular spatial frame plan consists of a number of rooms, plus circulation space, within a rectangular framework. The circulation space will be of two main types - a central corridor (suitable for the dual aspect plan) and a corridor which runs the length of the building on one side only (single aspect). A central hall plan was also considered, but excluded from the analysis; it has the smallest circulation area, but, within the constraints accepted in this study, it allows only limited flexibility of arrangement and room dimension. The single aspect plan allows maximum flexibility but has the greatest circulation area. With the dual aspect plan, the circulation area is half or less that of the single aspect plan and it also

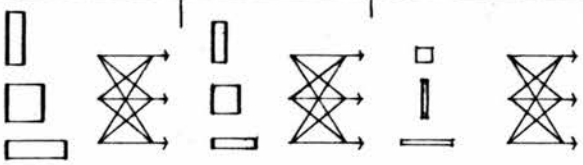
allows considerable flexibility of room arrangement or dimension.

The combination of rooms plus circulation space gives a series of patterns as shown in Fig. 4.1(a) where a general sketch of the plans is developed into a more detailed series of layouts. These are subjected to certain constraints to give a wide range of practical sample plans. In this diagram, variation of shape, plus orientation of arrangement are considered for the dwelling unit, the room unit, and circulation space. An explanation of the symbols used accompanies the diagram.

All the possible single aspect and double aspect plans are included in Fig. 4.1(b), but they can be divided into two types. The left hand column (b') shows plans with unequal random-sized spatial units; in the right hand column (b") plans are derived from modular basic spatial units. The circulation corridor may be either centrally situated or off-centre, and these alternatives are shown in Fig. 4.2 ('equal' = 'regular' or 'regulated' = 'modular'). Those with equal spatial units (rooms) are shown shaded in the lower part.

In order to make the rooms interchangeable, the regular plan is to be preferred and therefore has been chosen for study. All possible plans of this type are illustrated in Fig. 4.1 (b") and all are described as Modular Spatial Frame Plans. These plans can be broken down into 6 types depending on the given values of n and n'. Since the greatest flexibility is achieved with the plans in the central column (shown shaded frame type A B ··· F) in particular the plan where n = n' = 1 (Type C with darker shading), further discussion will be concentrated on this case.

(a) Basic Components of House Plan

	Dwelling unit	Room unit	Circulation	Room & circulation
Variation of shape Orientation Arrangement				
Constraint in shape, size and attitude	Rectangle two walls $Y/X = 1\text{-}2.4$ $D = 30\text{-}105m^2$	Rectangle two walls $1.5 \leq x,y \leq 3.6m$	Width of cori.= 1.1m Width of door= 0.8m	$1 \leq n,n' \leq 2$ $Q = mn + m'n'$ $6 \leq Q \leq 16$

(b) Possible Rectangular Frame Plans

(b') Unequal room frame plans

(b") Modular(Regular) spatial frame plans

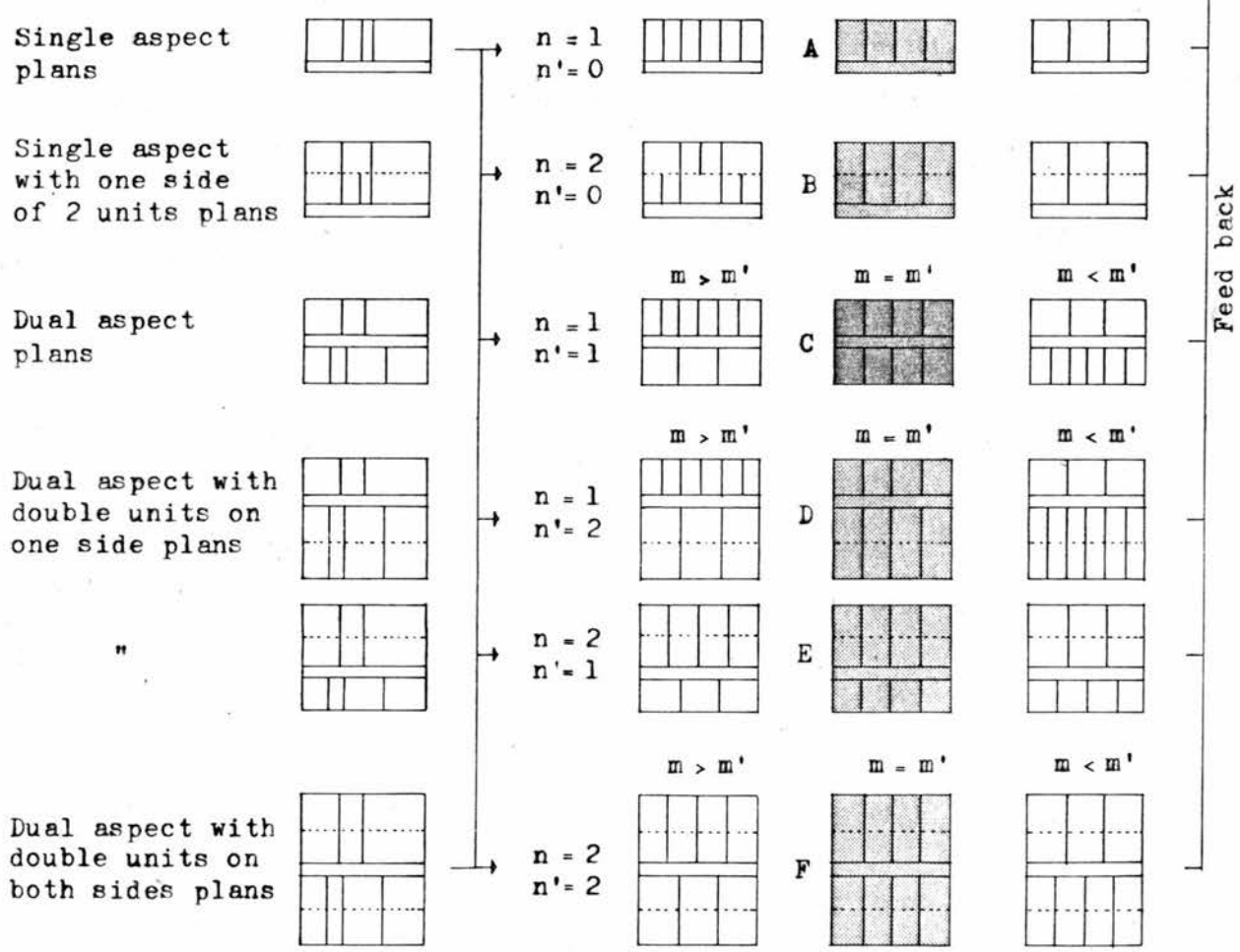


Fig. 4.1 Guidelines for the Formulation of Rectangular Frame Plans

(Shading: The greatest flexibility of house plan)
(Darker shading: Focus of the study to be chosen)

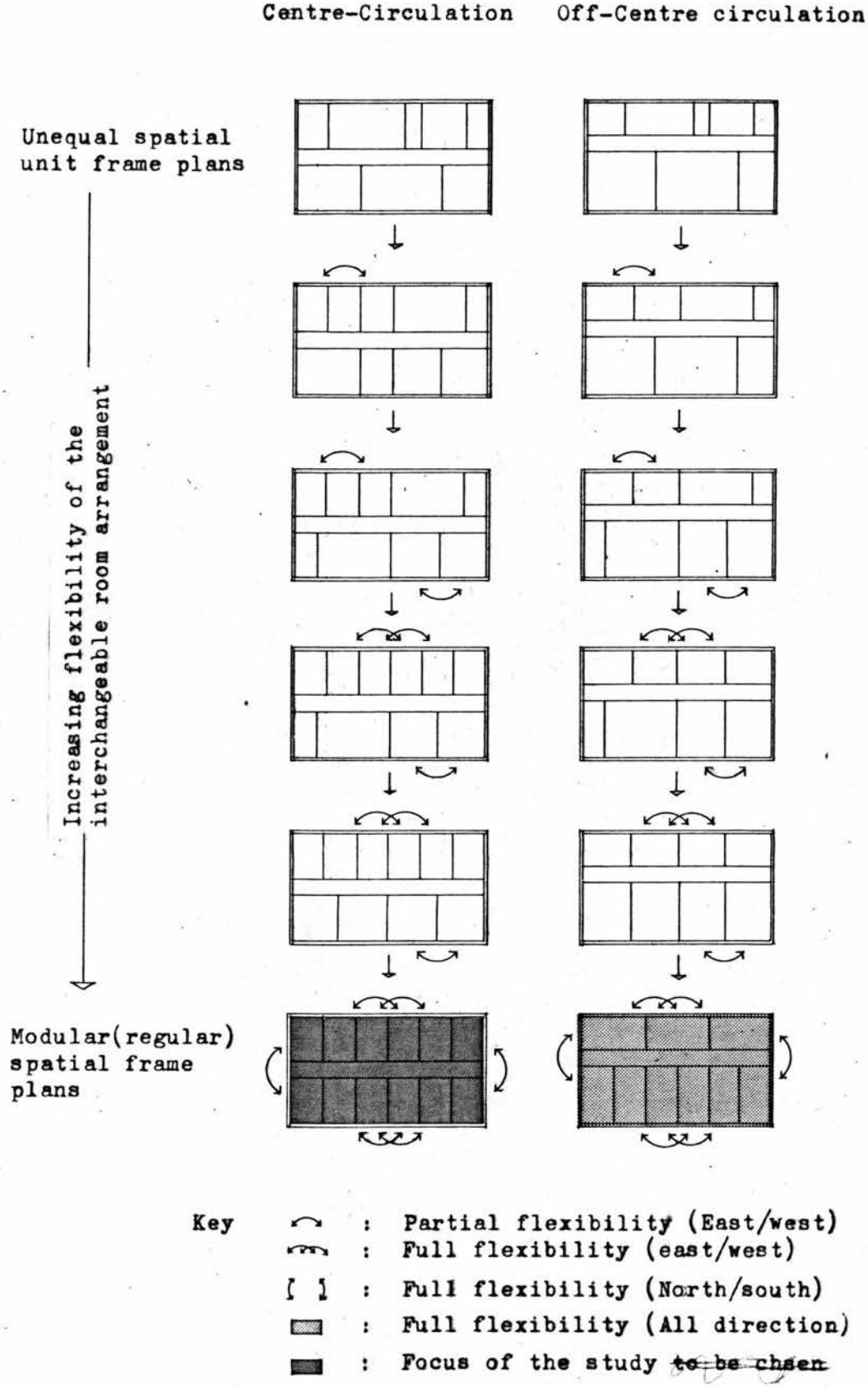


Fig. 4.2 Increasing Flexibility of the Interchangeable Room Arrangementsiin the Dual Aspect Frame Plans

3. MODIFICATION OF AREA AND DIMENSION AVAILABLE IN THE MODULAR FRAME PLAN.

3.1 Fractions for Frame Plan Types.

Within the frame plan there is a relationship between household size plus degree of functional segregation (Q), Dwelling area (D), width and depth of house plan (X, Y) and the number of north or south facing rooms.

$Q = h + f$, only $n = n' = 1$ is to be studied.
($Q = m + m' = 2m$ or $2m'$ and
$mx_N = m'x_S = X$
must be satisfied)

In order to satisfy this ($m \cdot x_N = m' \cdot x_S = X$) relationship, Q can be expressed as a series of 'fractions' as in Tables 4.1 and 4.2. The word 'fraction' was used to indicate a numeric statement expressing the number of north and south facing rooms. The denominator indicates the number of south facing rooms and the numerator is the number of north facing rooms. In the Table if Q ranges from 6 to 16, $m < m'$, twenty two possible 'fractions' (Td = C-1, C-2, ... C-22) result. If $m = m'$, six 'fractions' (Td = C'-1, C'-2, ... C'-6) result (Not every value of Q in the range results in a 'fraction' because not all are divisible by two). The symbol '2' indicates double unit rooms arranged north/south with the same width of rooms.

Table 4.1 shows the relationship between available frame plans (Td, represented by left vertical volumn) and possible variations of Q ranging from 6 to 16. The union

Table 4.1 Fractions for All Frame Plan Types with Simple Whole Number Proportions

($Q = mn + m'n'$, $mx_N = m'x_S$, $m \leq m'$, $1.5 \leq x_S, x_N \leq 3.6$)

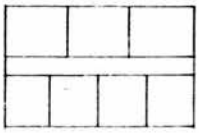
Type of Plan (T_d) \ Q	6	7	8	9	10	11	12	13	14	15	16
A1 - A11	6 →	7 →	8 →	9 →	10 →	11 →	12 →	13 →	14 →	15 →	16
B1 - B6	3^2 →	·	4^2 →	·	5^2 →	·	6^2 →	·	7^2 →	·	8^2
C1, C2	2/4 → 3/4	·	·	·	·	·	·	·	·	·	·
·	·	·	3/5 → 4/5	·	·	·	·	·	·	·	·
·	·	·	·	3/6 → 4/6	5/6	·	·	·	·	·	·
·	·	·	·	·	3/7	4/7 →	5/7	6/7	·	·	·
·	·	·	·	·	·	·	4/8	5/8	6/8	7/8	·
·	·	·	·	·	·	·	·	4/9	5/9	6/9	7/9
·	·	·	·	·	·	·	·	·	·	5/10	6/10
C22	·	·	·	·	·	·	·	·	·	·	5/11
C'1 - C'6	3/3 →	·	4/4 →	·	5/5 →	·	6/6 →	·	7/7 →	·	8/8
D1	·	·	$2/3^2$	·	·	·	·	·	·	·	·
·	·	·	·	·	$2/4^2$ → $3/4^2$	·	·	·	·	·	·
·	·	·	·	·	·	·	·	$3/5^2$ → $4/5^2$	·	·	·
D7	·	·	·	·	·	·	·	·	·	$3/6^2$ → $4/6^2$	
D'1 - D'4	$2/2^2$ →	·	·	$3/3^2$ →	·	·	$4/4^2$ →	·	·	$5/5^2$	·
E1	·	$2^2/3$	·	·	·	·	·	·	·	·	·
·	·	·	$2^2/4$ →	·	$3^2/4$	·	·	·	·	·	·
·	·	·	·	·	·	$3^2/5$	·	$4^2/5$	·	·	·
·	·	·	·	·	·	·	$3^2/6$	·	$4^2/6$	·	$5^2/6$
E10	·	·	·	·	·	·	·	$3^2/7$	·	$4^2/7$	·
E'1 - E'4	$2^2/2$ →	·	·	$3^2/3$ →	·	·	$4^2/4$ →	·	·	$5^2/5$	·
F1	$1^2/2^2$ →	·	·	·	$2^2/3^2$	·	·	·	·	·	·
·	·	·	·	·	·	$2^2/4^2$ →	·	·	$3^2/4^2$	·	·
F5	·	·	·	·	·	·	·	·	·	·	$3^2/5^2$
F'1 - F'3	·	·	$2^2/2^2$ →	·	·	·	$3^2/3^2$ →	·	·	·	$4^2/4^2$

Table 4.2 Relationship between Possible Range of Frame Plan Types, Q and Fractions

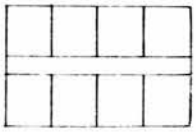
T_d \ Q	6 ↓	7 ↓	8 ↓	9 ↓	10 ↓	11 ↓	12 ↓	13 ↓	14 ↓	15 ↓	16 ↓	Symbol
C 1	2/4											C 1 (2/4)
C 2			3/4									C 2 (3/4)
C 3				3/5								C 3 (3/5)
C 4					4/5							C 4 (4/5)
C 5					3/6							C 5 (3/6)
C 6						4/6						C 6 (4/6)
C 7						3/7						C 7 (3/7)
C 8							5/6					C 8 (5/6)
C 9							4/7					C 9 (4/7)
C10								5/7				C10 (5/7)
C11								4/8				C11 (4/8)
C12									6/7			C12 (6/7)
C13									5/8			C13 (5/8)
C14									4/9			C14 (4/9)
C15										6/8		C15 (6/8)
C16										5/9		C16 (5/9)
C17											7/8	C17 (7/8)
C18											6/9	C18 (6/9)
C19											9/10	C19 (9/10)
C20											7/9	C20 (7/9)
C21											6/10	C21 (6/10)
C22											5/11	C22 (5/11)
C'1	3/3											C'1 (3/3)
C'2			4/4									C'2 (4/4)
C'3				5/5								C'3 (5/5)
C'4					6/6							C'4 (6/6)
C'5						7/7						C'5 (7/7)
C'6							8/8					C'6 (8/8)

Example

Q=7, C_2(3/4)



Q=8, C'2(4/4)



of Td and Q is a possible generic plan represented by a 'fraction' which may be chosen by a user/architect. For example if Q is 10, the possibilities (with given constraints: $Q = mn + m'n'$, $m x_N = m' x_S$, $m \leq m'$, $1.5 \leq x_N$ or $x_S \leq 3.6$) are 10 (i.e. A-5 frame plan in which m or m' = 0); 5^2 (i.e. B-3 frame plan in which m or m' = 0); $^4/_6$ or $^3/_7$ (i.e. C-6 or C-7 frame plan in which $m < m'$); $^5/_5$ (i.e. C'-3 frame plan in which $m = m'$); $^2/_{42}$ (i.e. D-2 frame plan in which $m < m'$); (none available for D' frame plan); $^{32}/_4$ (i.e. E-3 frame plan in which $m < m'$); (none available for E' frame plan).

Thus there are eight possible choices for Q = 10. However further study concentrates only on type C and C' frame plans which are the shaded part of Table 4.1.

Where the number of north and south facing rooms is unequal, the partition thickness (here assumed to be 0.1m) must be allowed for. Fig. 4.3 analyses the dimensional consequences for all arrangements of up to sixteen rooms (Q =16) in dual aspect plans for planning modules of 0.3 and 0.1m.

Except where north and south facing rooms are equal in number, it can be seen that, with a module of 0.3m., some compensatory adjustment is always necessary in order that the plan remains rectangular (i.e. $m x_N = m' x_S = X$).

As there are so many choices available study has again been limited to type C'-1, C'-2, ---- C'-6 frame plans which are typical examples of all those illustrated. It means that the number of spatial units facing north equal

(The variation of x_N respond to a sequence of x_S at the each Q and T_d)

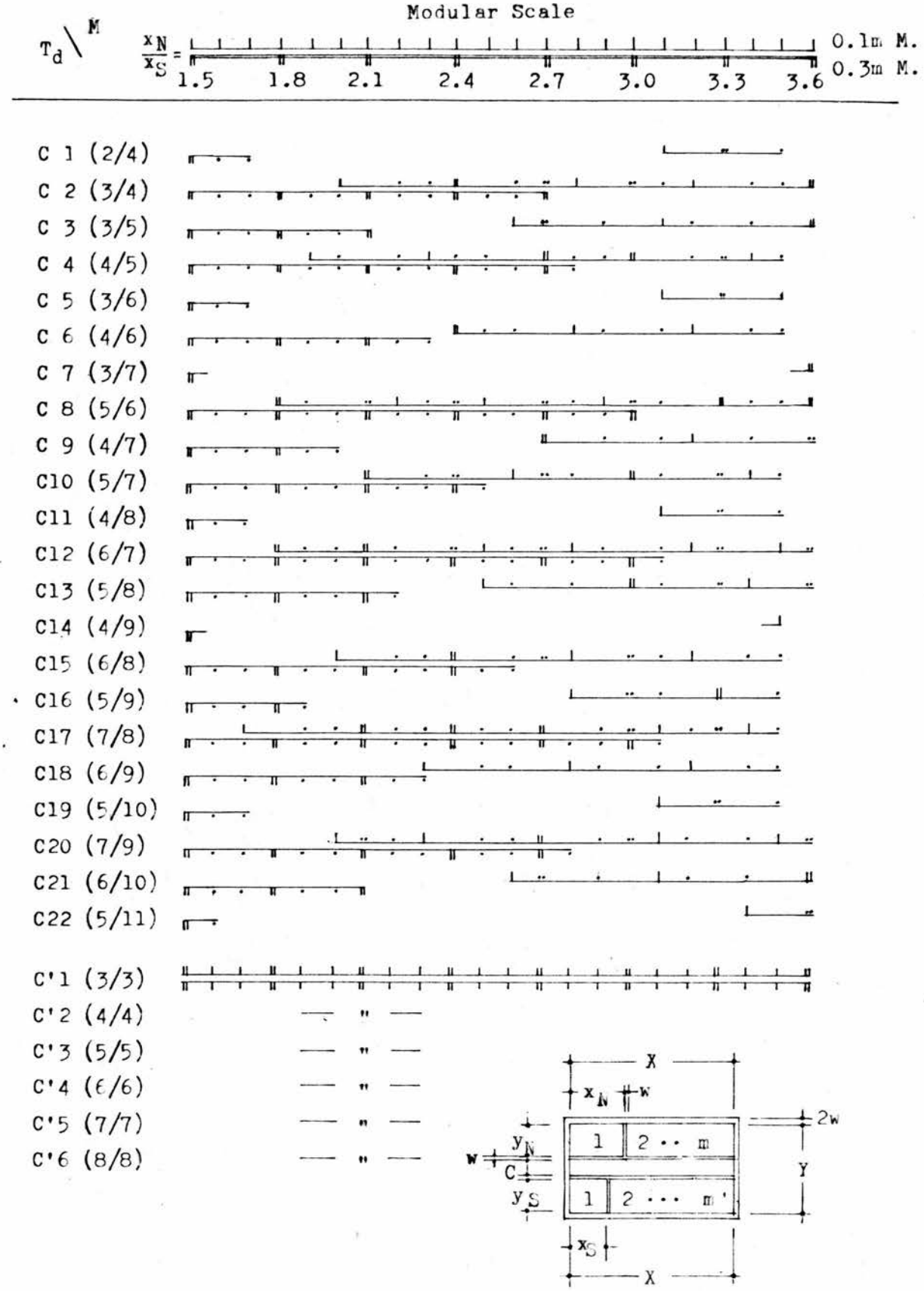


Fig. 4.3 Modification of the Dimension of Width of a North or South Facing Room to Correspond with the Width of the Room on the Opposing Side(Facing South or North)

the number facing south. These plans can be used with minimum adjustment of room width by any modular size of increment.

3.2 Configuration of House Plan, Frame Plan Types and Dwelling Areas.

Table 4.3 shows the relationship between the dimensions of house Plan (X, Y) with regard to

i) The overall configuration ratio required ($^{X}/_{Y}$)
ii) The depth of room preferred (y)
iii) The type of frame plan chosen (Td)
iv) The dwelling area afforded (D)

These values which are not constant are decided by the architect or user and are interdependent. The values shown inside the dotted lines indicate the most practical range of house plan configuration ratio ($^{X}/_{Y}$ = 1:1 – 1:2.4). If a particular figure (e.g. $^{X}/_{Y}$ = 1:1.6 [1]) as an optimum configuration ratio is required, it can be found within the dotted lines and it is also underlined.

The table is used to find the X and Y dimensions, with given data (e.g. depth of room, y, type of frame plan (Td) and dwelling area (D)). For example if we wish to find the X and Y dimensions when the plan type is C, the dwelling area is 75m^2 and the optimum configuration required is 1:1.6, then y is 2.7m (because the planning module is 0.3m).

These relationships are illustrated graphically in a simplified diagram in Fig. 4.4. The shaded area represents

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1. See Chap. II 5.2, Fig. 2.15.

Table 4.3-1 Variation of Frontage(X) in Relation to Room Depth(y), Frame Plan Type(T_d) and Dwelling Area(D) within a Given Range of Configuration Ratios(X/Y)

($X=D/Y$, $1.8 \leq y \leq 3.6$m, $y_N=y_S$, $C=1.1$m, $w=0.1$m, $6 \leq Q \leq 16$. X and Y dimensions are indicated between inside of exterior walls)

y	T_d=	A						B, C and C'						
		Y= y + C + w, X≥9m						Y= 2y + C + 2w, X≥4.5m						
	Y	D= 30	45	60	75	90	105	Y	30	45	60	75	90	105m²
3.6	4.8	-	9.37	12.50	15.62	18.75	21.87	8.5	-	5.29	7.05	8.82	10.58	12.35
3.5	4.7	-	9.57	12.76	15.95	19.14	22.34	8.3	-	5.42	7.22	9.03	10.84	12.65
3.4	4.6	-	9.78	13.00	16.30	19.56	22.82	8.1	-	5.55	7.40	9.25	11.11	12.96
3.3	4.5	-	10.00	13.33	16.66	20.00	23.30	7.9	-	5.69	7.59	9.49	11.39	13.29
3.2	4.4	-	10.22	13.63	17.00	20.45	23.86	7.7	-	5.84	7.79	9.74	11.48	13.63
3.1	4.3	-	10.46	13.95	17.44	20.93	24.41	7.5	-	6.00	8.00	10.00	12.00	14.00
3.0	4.2	-	10.71	14.28	17.85	21.42	25.00	7.3	-	6.16	8.21	10.27	12.32	14.38
2.9	4.1	-	10.91	14.63	18.29	21.95	25.60	7.1	-	6.33	8.45	10.56	12.67	14.78
2.8	4.0	-	11.25	15.00	18.75	22.50	26.25	6.9	-	6.52	8.69	10.86	13.04	15.21
2.7	3.9	-	11.53	15.38	19.23	23.07	26.92	6.7	-	6.71	8.95	11.19	13.43	15.67
2.6	3.8	-	11.84	15.78	19.73	23.68	27.63	6.5	4.68	6.92	9.23	11.53	13.84	16.15
2.5	3.7	-	12.16	16.21	26.27	24.32	28.37	6.3	4.76	7.14	9.52	11.98	14.28	16.66
2.4	3.6	-	12.50	16.66	20.83	25.00	29.16	6.1	4.91	7.37	9.83	12.29	14.35	17.21
2.3	3.5	-	12.85	17.14	21.42	25.71	30.00	5.9	5.08	7.62	10.16	12.71	15.25	17.79
2.2	3.4	-	13.23	17.64	22.05	26.47	30.88	5.7	5.26	7.89	10.52	13.15	15.78	18.42
2.1	3.3	9.09	13.63	18.18	22.72	27.27	31.81	5.5	5.45	8.18	10.90	13.63	16.36	19.09
2.0	3.2	9.37	14.06	18.75	23.43	28.12	32.81	5.3	5.66	8.49	11.32	14.15	16.98	19.81
1.9	3.1	9.67	14.51	19.35	24.19	29.03	33.87	5.1	5.88	8.82	11.76	14.70	17.64	20.58
1.8	3.0	10.00	15.00	20.00	25.00	30.00	35.00	4.9	6.12	9.18	12.24	15.30	18.36	21.42

Shading: Practical available ranges (X/Y=1:1 - 1:2.4)
Underlined: Assumption of optimum configuration (X/Y=1:1.6)

Table 4.3-2 Variation of Frontage(X) in Relation to Room Depth(y), Frame Plan Type(T_d) and Dwelling Area(D) within a Given Range of Configu ationrRatios(X/Y)

(X=D/Y, $1.8 \leq y \leq 3.6$m, $y_N = y_S$, C=1.1m, w=0.1m, $6 \leq Q \leq 16$. X and Y dimensions are indicated between insides of exterior walls)

y	T_d=	D,E, and E'						F and F'						
		Y = 3y + C + 3w, X>3m						Y = 4y + C + 4w, X>3m						
	Y	D= 30	45	60	75	90	105	Y	30	45	60	75	90	105 m^2
3.6	12.2	-	3.68	4.91	6.14	7.37	8.60	15.9	-	-	3.77	4.71	5.66	6.60
3.5	11.9	-	3.78	5.04	6.39	7.56	8.82	15.5	-	-	3.87	4.83	5.80	6.77
3.4	11.6	-	3.87	5.17	6.46	7.75	9.05	15.1	-	-	3.97	4.96	5.96	6.95
3.3	11.3	-	3.98	5.30	6.63	7.96	9.29	14.7	-	3.06	4.08	5.10	6.12	7.14
3.2	11.0	-	4.09	5.45	6.81	8.18	9.54	14.3	-	3.14	4.19	5.24	6.29	7.34
3.1	10.7	-	4.20	5.60	7.00	8.41	9.81	13.9	-	3.23	4.31	5.39	6.47	7.55
3.0	10.4	-	4.32	5.76	7.21	8.65	10.09	13.5	-	3.33	4.44	5.55	6.66	7.77
2.9	10.1	-	4.45	5.94	7.42	8.91	10.39	13.1	-	3.43	4.58	5.72	6.87	8.01
2.8	9.8	3.06	4.59	6.12	7.65	9.18	10.71	12.7	-	3.54	4.72	5.90	7.08	8.26
2.7	9.5	3.15	4.73	6.31	7.89	9.47	11.05	12.3	-	3.65	4.87	6.09	7.31	8.53
2.6	9.2	3.26	4.89	6.52	8.15	9.78	11.41	11.9	-	3.78	5.04	6.30	7.56	8.82
2.5	8.9	3.37	5.05	6.74	8.42	10.11	11.79	11.5	-	3.91	5.21	6.52	7.82	9.13
2.4	8.6	3.48	5.23	6.97	8.72	10.46	12.20	11.1	-	4.05	5.40	6.75	8.10	9.45
2.3	8.3	3.61	5.42	7.22	9.03	10.84	12.65	10.7	-	4.20	5.60	7.00	8.41	9.81
2.2	8.0	3.75	5.62	7.58	9.37	11.25	13.12	10.3	-	4.36	5.82	7.28	8.73	10.19
2.1	7.7	3.89	5.84	7.79	9.74	11.68	13.63	9.9	3.03	4.54	6.06	7.57	9.09	10.60
2.0	7.4	4.05	6.08	8.10	10.13	12.16	14.18	9.5	3.15	4.73	6.31	7.89	9.47	11.05
1.9	7.1	4.22	6.32	8.45	10.56	12.67	14.78	9.1	3.29	4.94	6.59	8.24	9.89	11.53
1.8	6.8	4.41	6.61	8.82	11.02	13.23	15.44	8.8	3.40	5.11	6.81	8.52	10.22	11.93

Shading: Practical available ranges (X/Y=1:1 - 1:2.4)
Underlined: Assumption of optimum configuration (X/Y=1:1.6)

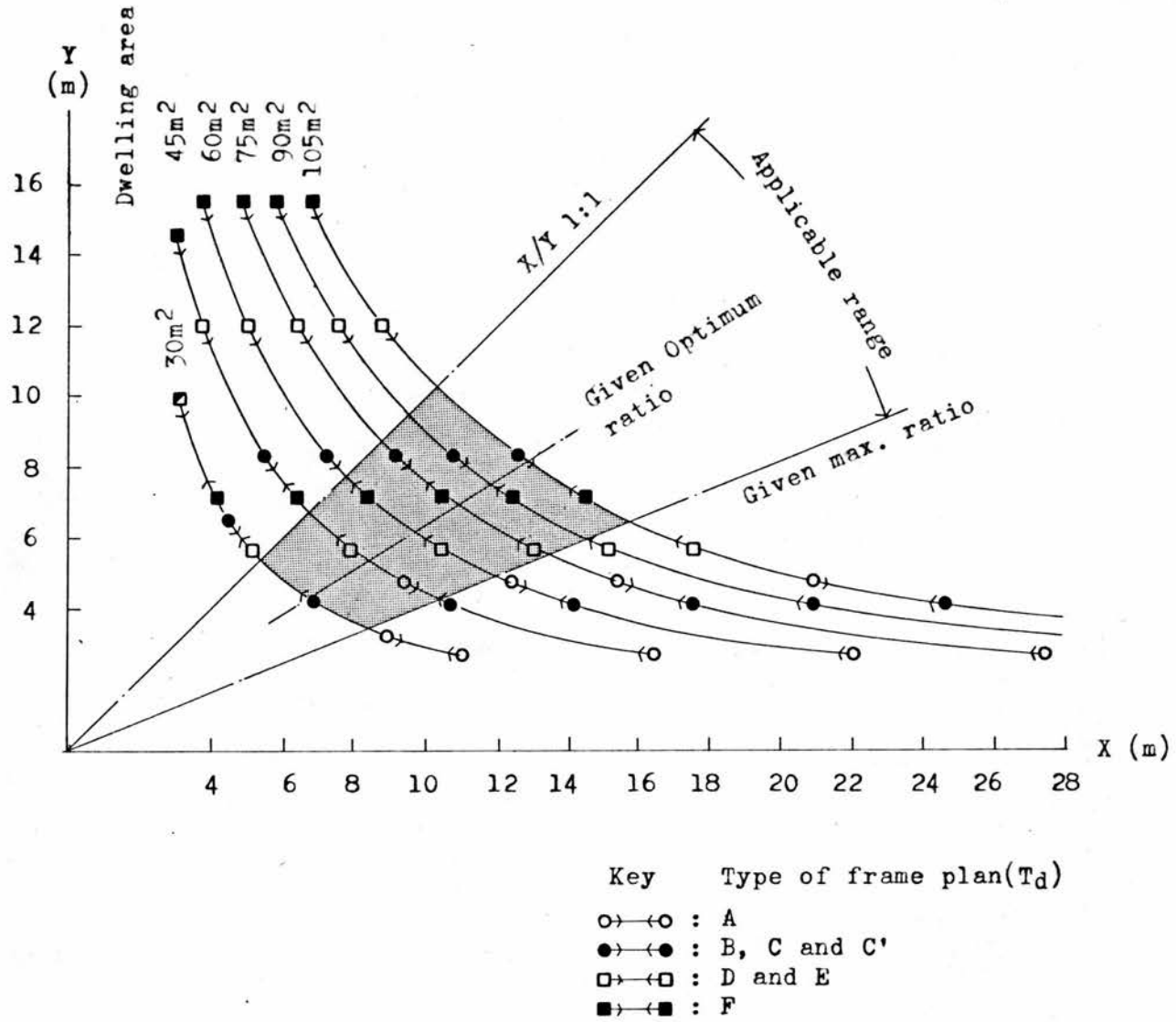


Fig. 4.4 Relationship between Dwelling Area, Optimum Shape and Overall Dimensions Resulting in a Practical Range of Frame(House) Plan Types

the relevant range of frame plan types and dwelling areas with given X and Y dimensions.

4. SUMMARY AND CONCLUSIONS.

This chapter has dealt with all the possible frame plans; these have been analysed to ascertain which arrangements allow maximum interchangeability of rooms according to the user/architect's requirements.

The special case of the rectangular dual-aspect plan, with an equal number of north and south facing rooms, was selected for the case study. The results of this analysis are most concisely expressed in Table 4.3, which takes into account the factors of the overall configuration ratio ($^{X}/_{Y}$), the type of frame plan (Td), the household size plus the functional segregation (Q), the dwelling area (D), and the dimensions (x and y) of the spatial unit.

Certain assumptions about the variation of spatial unit (room) dimension, upon which the preceding analysis was based, will now be investigated in Chapter V.

CHAPTER V

A GUIDELINE FOR THE PLANNING AND DESIGN OF A COMPACT ROOM

1. INTRODUCTION.
2. FLOW SYSTEM WITH CRITERIA.
3. GRID MODULAR PLAN AND LINEAR GRAPHIC INDEX.
4. EXAMPLE OF PLANNING AND DESIGN OF A COMPACT ROOM.
5. ADJUSTMENT OF THE COMMON AREA AND DIMENSION OVER ROOM.
6. SUMMARY AND CONCLUSIONS.

1. INTRODUCTION.

The configuration of the frame plan is determined by the minimum room area/dimension and the required number of spatial units. A systematic variation was devised to investigate this and find the appropriate area and dimension. These depend on such widely different factors as the arrangement of the fittings, space standards, and living style and are also limited by the location of openings in the enclosing walls. Each country's norms controlling these must also be applied to all rooms. A basic flow system was devised to illustrate this.

Variation of the dimensions of each room as a compact space unit was mapped out on a given modular grid plan using an increment of 0.3m as an example.

This variation was devised to be shown on a simple diagram from which is derived a linear graphic index, shown in Fig. 5.2, which allows a convenient reference. These proposed indices were devised to find a common area and dimension which would allow maximum interchangeability of rooms with the minimum extra dimension or adjustment area if needed.

2. FLOW SYSTEM AND CRITERIA.

There are seven important factors which determine the area and dimensions of a compact room:

i) The spatial unit.
ii) Wall constraints (i.e. location of window and door.

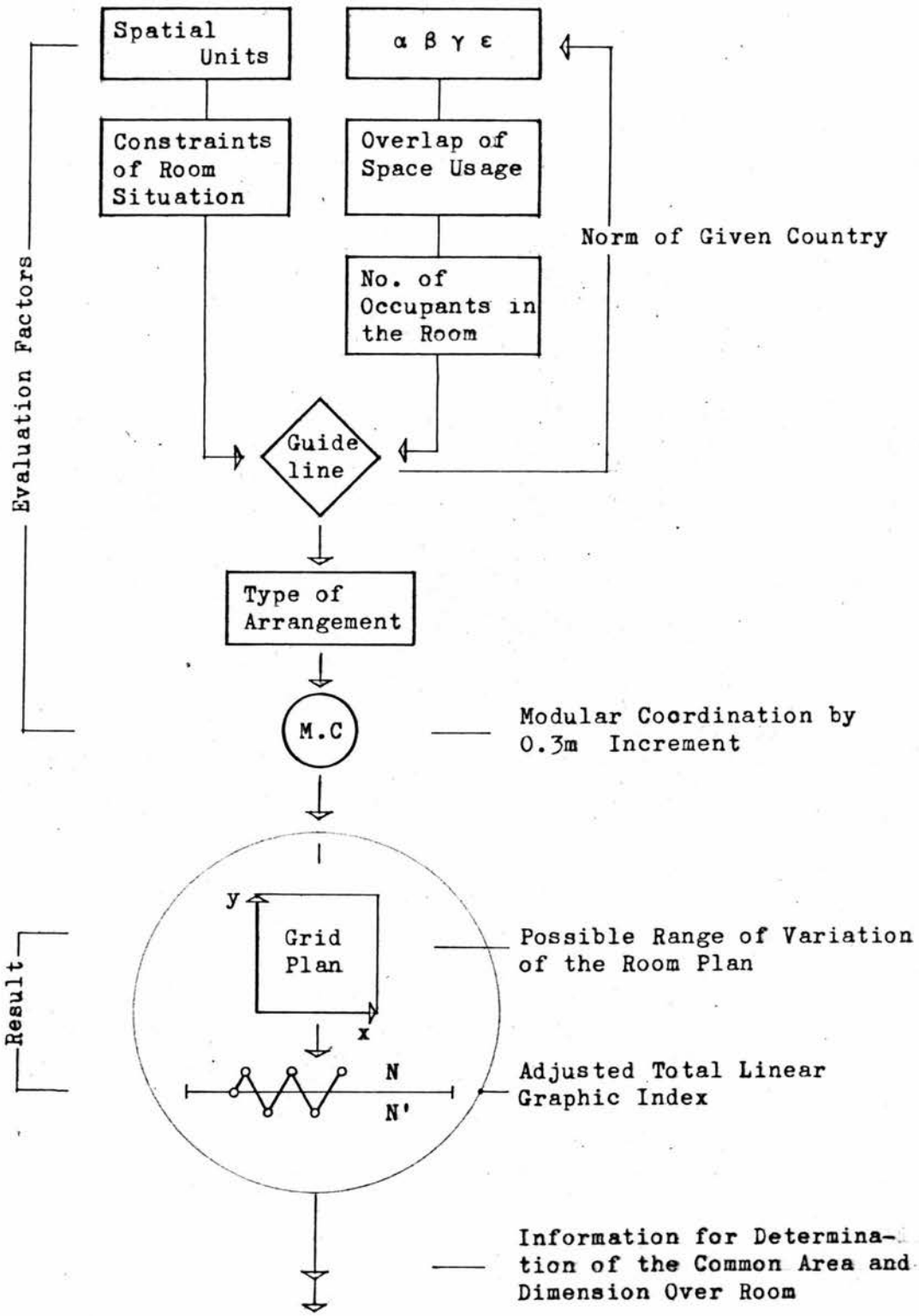


Fig. 5.1 Flow System for the Generation of Compact Room Areas and Dimensions

iii) Space standards (i.e. norms in given country)
iv) Overlap space usage.
v) Fitting arrangement (accepted design).
vi) Number of occupants (i.e. number of persons in each room).
vii) Module size.

If these factors are given constant values, there can only be one resultant dimension; but if they vary, a number of possible dimensions are produced. In this thesis, the spatial unit and the wall constraints are constant. The space standards used are the norms for the U.K. and Korea. An allowance is made for overlapping in space usage. Accepted arrangements for layout of fittings are considered. The number of occupants in a house may vary if there are guests but it is assumed that in each single bedroom (one spatial unit), there will be one person, as in the bathroom, etc., and there will be two in a double bedroom, etc. If, as in Fig. 5.1, these factors are 'fed-in' to the grid plan then certain dimensions will result. Different input criteria will produce different results.

3. GRID MODULAR PLAN AND LINEAR GRAPHIC INDEX.

All of the results found in the previous section for room configuration and area to be applied in practice are shown on two diagrams, the grid modular plan and the linear graphic index. The grid modular plan cross section is divided into 0.3m increments to illustrate the rectangular shape of the rooms, within the range of 1.5 to 3.6m in each plan dimension.

Diagram, Fig. 5.2-1(b) shows a simplified version of Fig. 5.2-1(a) in which each configuration (area and dimension) within the variation is given its own series number (N) and character of rectangular shape by adding "'" to the number. N and N' have the same value but N indicates an east/west ($x > y$) rectangle and N' is a north/south ($y > x$) rectangle. Those numbers on the diagonal line indicate a square. As shown in Fig. 5.2-2 the series numbers (N or N') are similarly arranged in order on a horizontal axis. In the graph, the gradient of increment of area increases steeply with room dimension. So for a small house a dimension of less than N=24 is desirable as anything larger than this will produce a much greater area.

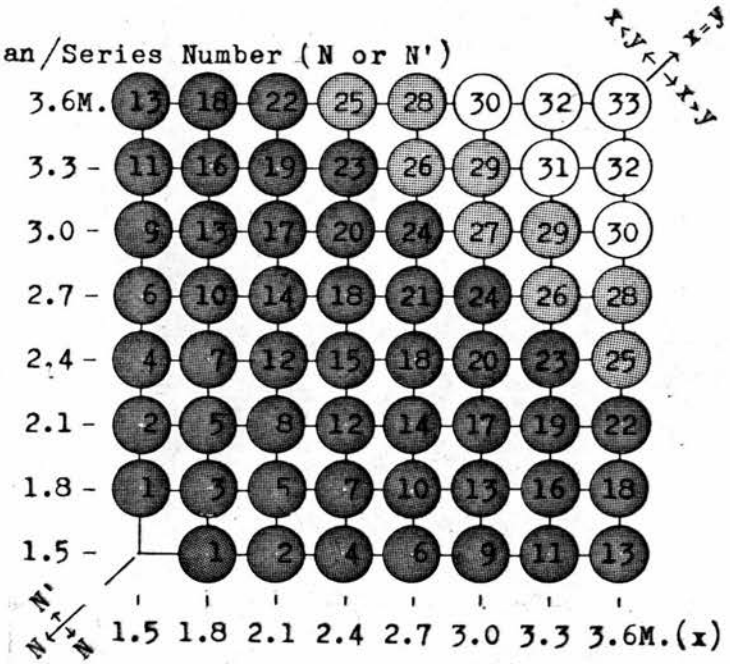
The linear graphic index is devised as a simple indicator of the area and dimension of room transferred from the grid module plan as shown in Fig. 5.2-1(b). The same information is illustrated as in Fig.5.2-1(c)with 'N' corresponding to N and N' to N'. Those figures below the horizontal line are the same as those below the diagonal line ($x = y$) in Fig. 5.2(b) and the same figures are again on the horizontal line.

(a) Area and Dimension (R = xy)

(y)	1.5	1.8	2.1	2.4	2.7	3.0	3.3	3.6M. (x)
3.6M.	5.40	6.48	7.56	8.64	9.72	10.80	11.88	12.96
3.3	4.95	5.94	6.93	7.92	8.91	9.90	10.89	11.88
3.0	4.50	5.40	6.30	7.20	8.10	9.00	9.90	10.80
2.7	4.05	4.86	5.67	6.48	7.29	8.10	8.91	9.72
2.4	3.60	4.32	5.04	5.76	6.48	7.20	7.92	8.64
2.1	3.15	3.78	4.41	5.04	5.67	6.30	6.93	7.56
1.8	2.70	3.24	3.78	4.32	4.86	5.40	5.94	6.48
1.5		2.70	3.15	3.60	4.05	4.50	4.95	5.40

x=y

(b) Grid Plan/Series Number (N or N')



(c) Linear Graphic Index/Series Number (N or N')

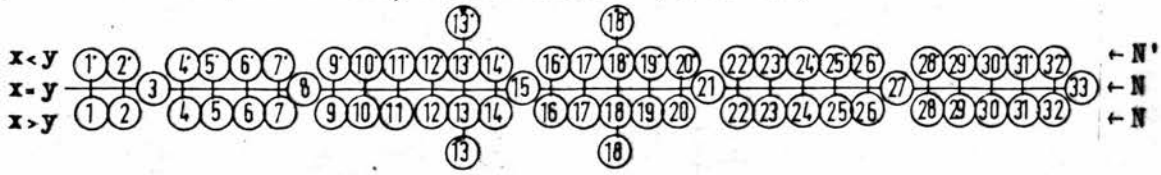


Fig. 5.2-1 Controlling Dimensions and Modular Sizes on the 0.3M. Basic Module Grid

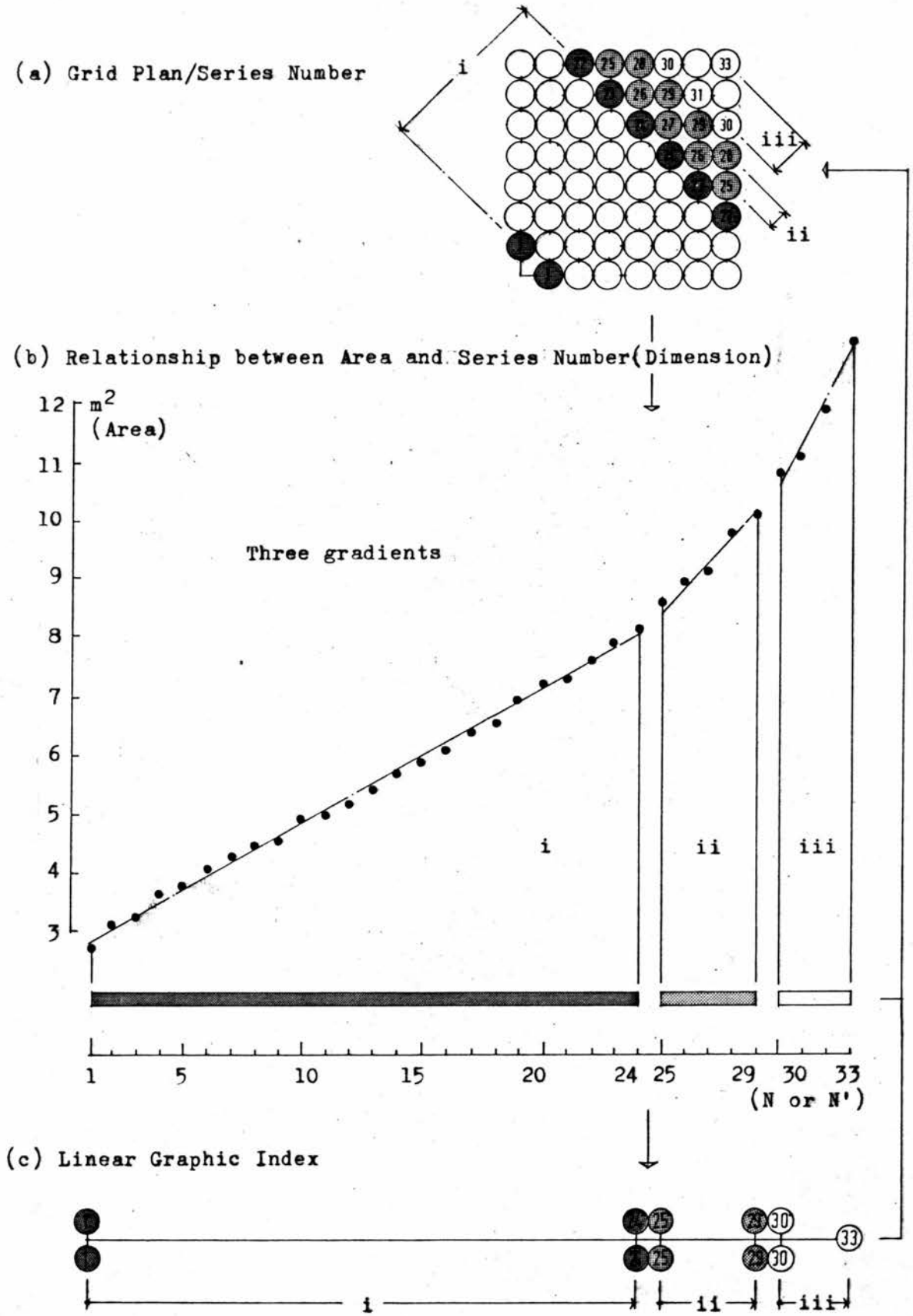


Fig. 5.2-2 Three Gradients in Relationship between Area and Series Number(Dimension)

4. EXAMPLE OF PLANNING AND DESIGN OF A COMPACT ROOM.

In this thesis, the rooms which are considered with regard to the planning and design of the compact room are:

i) Living room
ii) Bed/sitting room
iii) Dining room
iv) Kitchen
v) Bathroom/W.C.
vi) Entrance Hall.
vii) Other rooms (Utility, extra room and children's playroom).

To find the area and dimension of the compact room, each of the following factors are considered for each individual room.

(a) Appropriate number of spatial units and constraints of room situation (window and access point should be located on opposite side of the room and two blind walls should always face each other).

(b) Preference of room depth within the variation of ranges from 1.5 to 3.6m with 0.3m increments (different room depths give different dimensions and people can choose the shape/dimension they prefer).

(c) Other criteria to consider are the different norms of the U.K. and Korea. The norm of the U.K. drawn from British Space Standards[1], is considered as the highest standard at the moment. The norm of Korea, considered as the lowest one, is drawn from some general assumptions or individual suggestions, from the

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1. Department of the Environment, Homes for Today and Tomorrow, 1961.
Scottish Development Department, Metric Space Standards, 1968.
L. Fairweather and J.A. Sliwa, A. J. Metric Handbook, 1975.

results of surveys conducted by the author in 1975[1] because in Korea space standards have not yet been established.

(d) A number of occupants appropriate for the size of the room and its fittings is considered.

(e) The number of possible arrangements in keeping with the space standards, is dependent on the number of occupants/users and an activity analysis.[2]

(f) The area of permissible overlap activity space must also be considered.

(g) There is a slight difference between the Korean living room, bed/sitting room and entrance hall, and the corresponding U.K. rooms, resulting from the different living styles in these two countries. These differences will be discussed later.

The relationship between these factors can be illustrated on diagrams (including the grid modular plan and linear graphic index) which show the variation of minimum dimension and area resulting from room depth preference, number of occupants, arrangement of fittings and space standards.

An example of planning and design for the seven specified rooms is given in the following section.

4.1 Living Room.

Given Factors

(i) Two spatial units are allowed for the living room (to save circulation space in the living room, the wall adjoining the corridor has been removed, making

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1. See Appendix F (pp. 180-181).
2. Ministry of Housing and Local Government, Housing Planning (A Guide to User Needs with a Check List), 1968.

the living room larger than the area of two spatial units alone. In this case an overlap of space usage occurs).

(ii) Living room dimensions are similar in both the U.K. and Korea, but in Korea some people still retain the tradition of sitting on 'pang-suk' (floor cushions) although others have changed to the western habit of sitting on a chair at a table. In those cases where 'pang-suk' are used, the overall required dimension can be reduced slightly because no allowance needs to be made for a table as dishes are set on the floor in front of the cushions.

In Fig. 5.3(b), the areas required in each case are compared, and sizes for fittings and activity space are given.

(iii) The arrangement of fittings in the living room depends on the relationship between the seats and the wall unit (which may contain the television and ornaments, a fire (if one is included) and the window. These objects can be termed 'focal points'[1] and the seating arrangement should be such that they can always be seen. Eye contact must also be considered. Therefore four basic suitable arrangements of seats (types of I, L, double I & U. See Fig. 5.3(c)) are produced.

Fig. 5.3 illustrates the relationship of these given factors: (a) shows the spatial unit and room constraints; (b) space standards of fittings and

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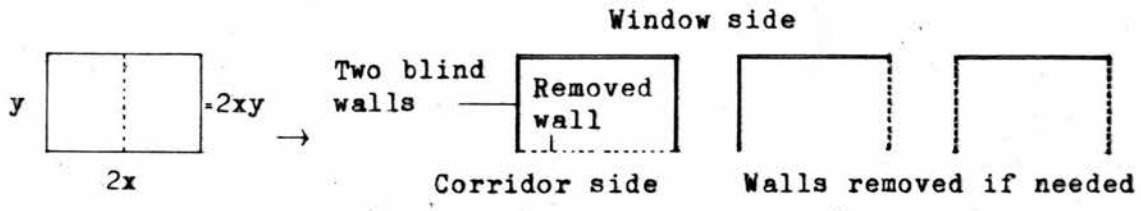
1. D. Canter, J. Gilchrist, J. Miller and N. Robert, An Empiral Study of the Focal Point in the Living Room, 1974.

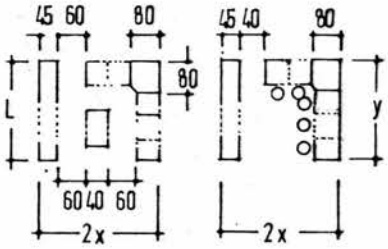
(a) Spatial Unit and Wall Constraints



(b) Space Standards of fittings and Activity

	(UK)[1]	(Korea)[2]
i. Fittings		
Easy chair	75 x 70	75 x 70
Pang-suk	-	75 x 70
Corner table or space	80 x 80	80 x 80
Length of wall cabinet	L ≤ 2.40	L ≤ 2.10
Width of tea table	≥40	≥40
Width of tray		≥30
ii. Activity space		
Width of passage	≥60	≥40
Minimum distance required when people sit opposite each other	≥2.40 (2.10)	≥2.40 (2.10)

Example T_2'' (UK) (Korea)

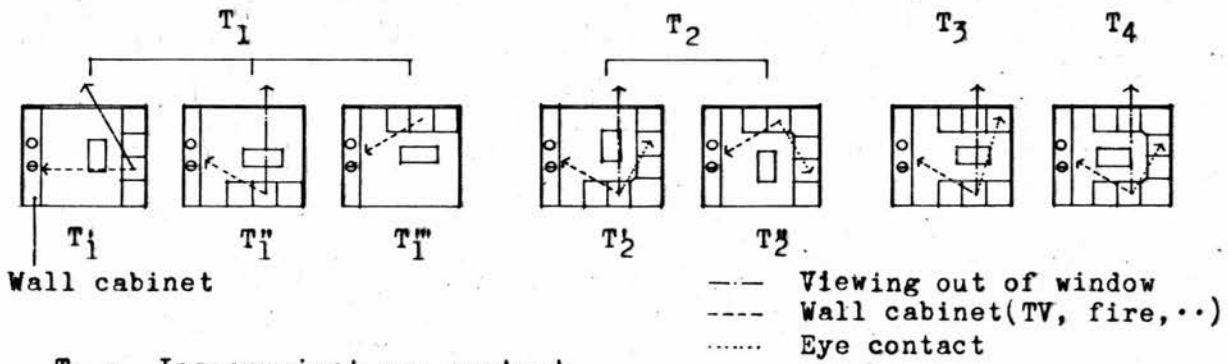


()···Only use in T_1''

(c) Arrangements Resulting from Combination of the Three Focal Points

Three focal points: Wall cabinet(TV, fire,···); looking out of window; eye contact

Possible arrangement of fittings(4-8 seats) are



T_1 : Inconvenient eye contact
(T_1''' Inconvenient viewing out of window but giving a feeling of more space)
T_2 : Easy eye contact (T_2'' Inconvenient viewing out of window)
T_3, T_4 : Easy eye contact less convenient for looking out of window

Result (Adjusted by 0.3m module)

UK 2.55(3.00)≤2x≤6.55(6.60), 2.40≤y≤3.50(3.60)
Korea 2.40(3.00)≤2x≤6.55(6.60), 1.75(2.10)≤y≤3.50(3.60)

Fig. 5.3 Evaluation Factors for Living Room

1. See Appendix E (pp. 175 - 179)
2. See Appendix F (pp. 180 - 181)

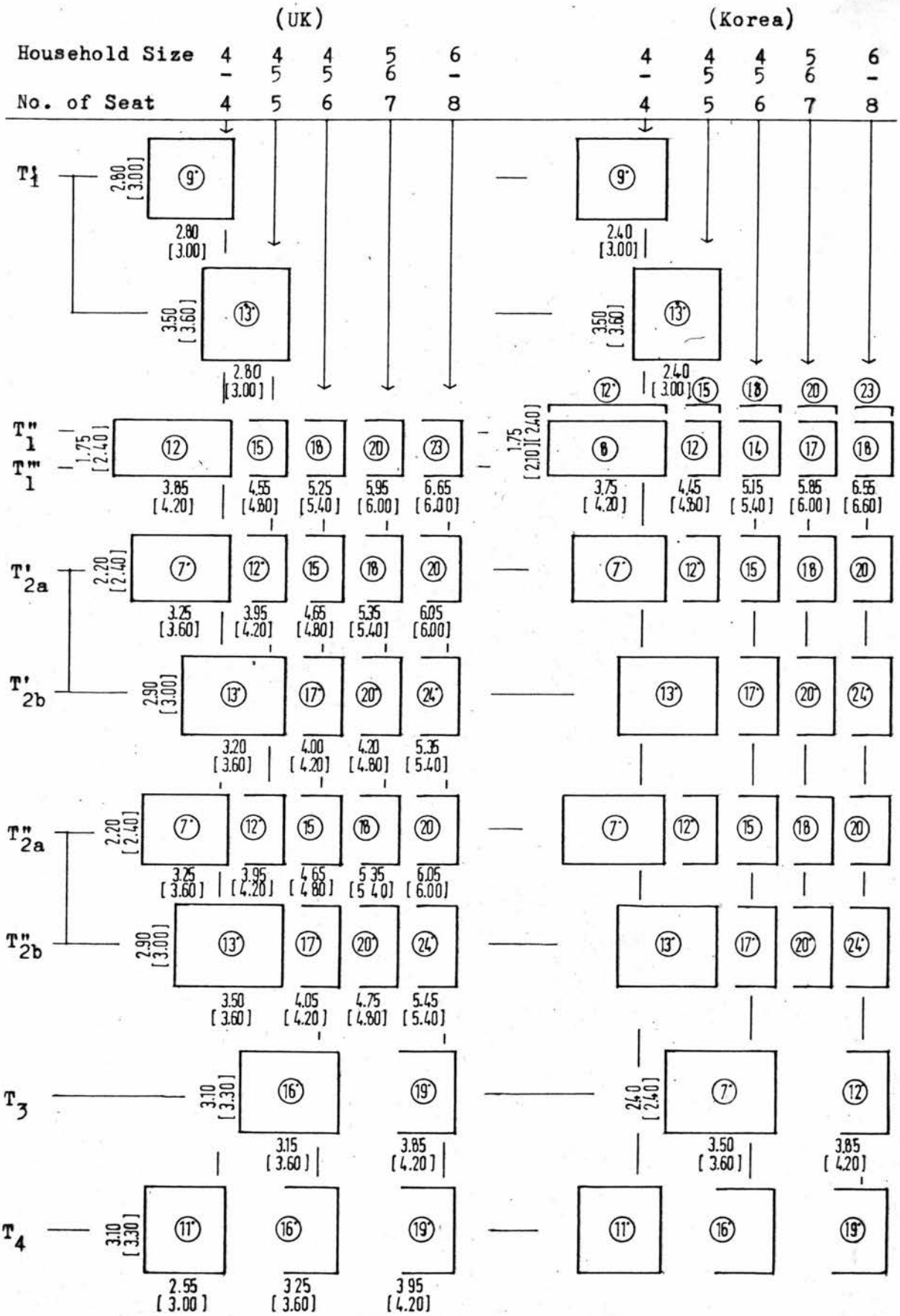


Fig. 5.4 Practical Possible Compact Living Rooms in Systematic Variation

activity; (c) arrangements resulting from the combination of three focal points.

The Results

Fig. 5.4 shows the only possible practical plans for a compact living room which are produced from the evaluation factors indicated in Fig. 5.3. These plans for both the U.K. and Korea show the number of seats for 4 to 8 people for household sizes of 4 to 6. The possible room dimensions in a systematic variation are illustrated on the linear graphic index and modular grid plan in Figs. 5.5 (the U.K.) and 5.6 (Korea).

Figs. 5.5(a) and 5.6(a) show the relationships between the number of seats, each type of arrangement ($T_r = T_{1.2.3.\cdots}$), and the series numbers (N or N'). From this diagram it can be seen which types of arrangement require less area by the given number of seats. T_N is the total linear graphic index which shows all those numbers (N or N') already given in T_1, $T_2 \cdots$.

Figs. 5.5(b) and 5.6(b) show the same numbers on a grid plan. The numbers at the right (or extreme right) and top of the grid plan can only increase by a further 0.3m increment. All the numbers within the grid plan are capable of increasing by 0.3m. T_{NA} is the adjusted total linear graphic index taking these increases into consideration.

The same information is expressed in two different forms in Figs. 5.5(c) and 5.6(c); the significance of T_{NA} will become clear in the discussion below of common dimen-

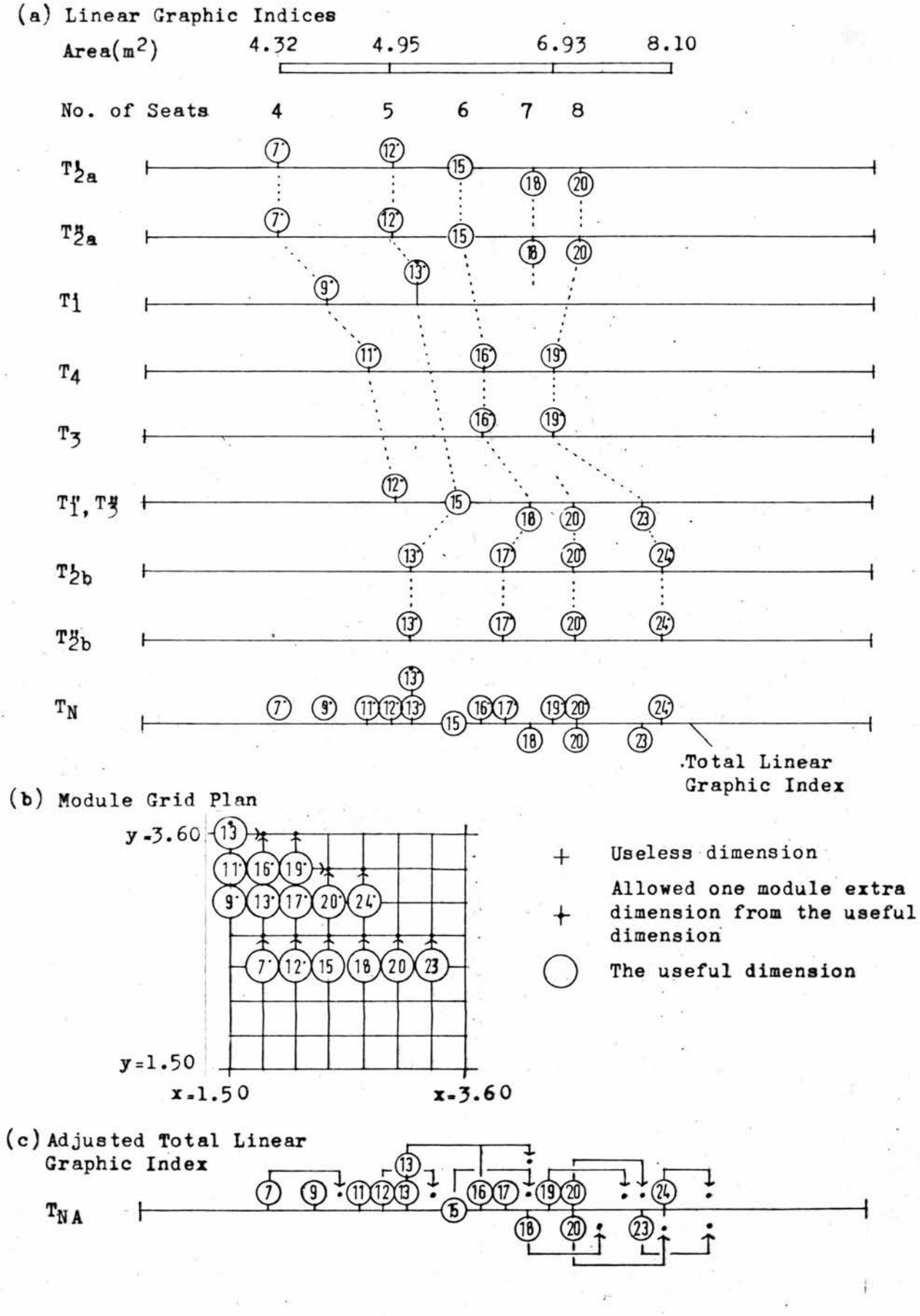


Fig. 5.5 Useful Dimensions of the Variation of Living Room Size Evaluated by the UK Norm

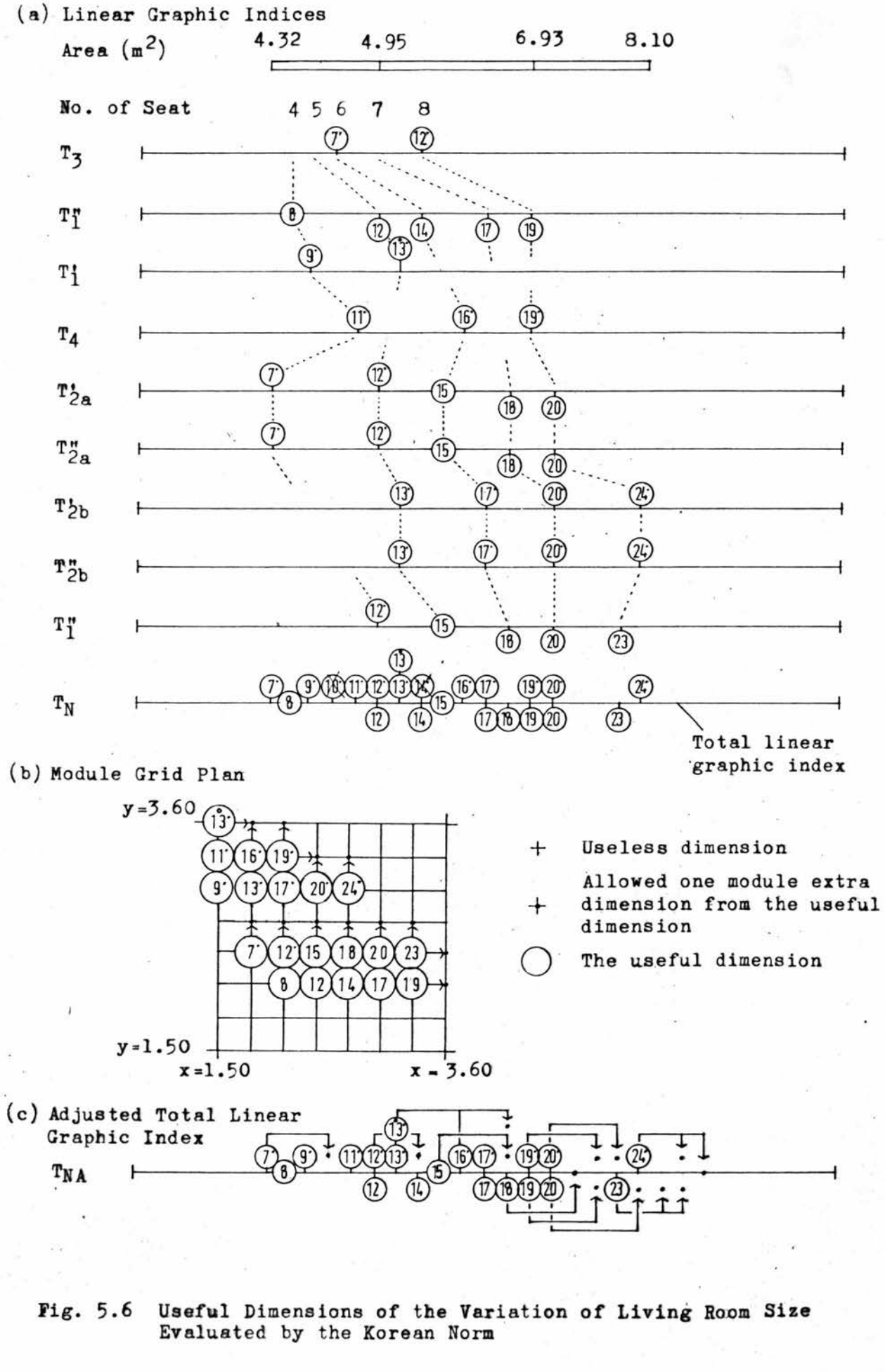


Fig. 5.6 Useful Dimensions of the Variation of Living Room Size Evaluated by the Korean Norm

sions and areas of rooms.

4.2 Bed/Sitting Room.

Given Factors

(i) One spatial unit is provided for each member of the household. However if there are two living together (i.e. parents or young children) the wall between two spatial units can be removed to give one room which has the area of two units. Rooms should be large enough for people to work, sleep and dress, and should also be able to seat one or two persons comfortably.

(ii) For these activities the basic furniture required is a work table, a dressing table, a wardrobe/cupboard (for hanging clothes and storing linen), and a bed. There is little difference in the space standards for these fittings in the U.K. and Korea. For exact details see Fig. 5.7(b). However there is a difference in the use of the bed. In Korea people sit and sleep on cushions or matresses spread on the 'Ondol' floor[1]. These are stored in closets[2] and brought out as needed, so that in the day time the bed space can be used for other activities.
If the work table and wardrobe/closet are positioned sensibly, the bed/sitting space can be utilized efficiently. Possible arrangements are given in Fig. 5.7(c). Of the six types shows (T_1, T_2 .... T_6), the most suitable is the first one (T_1). A wall unit

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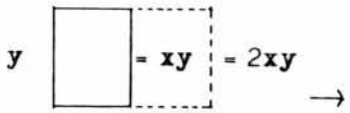
1. See Appendix H (p. 185).
2. Allowance has been made for this storage.

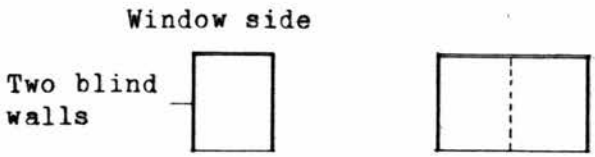
(a) Spatial Unit and Wall Constraints

Spatial unit



(2x for 2 persons)

Wall consraints

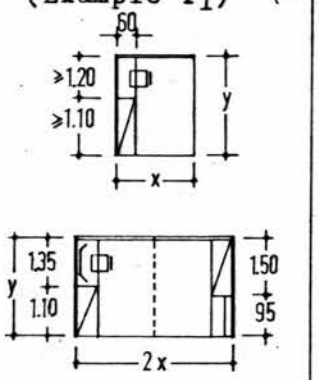


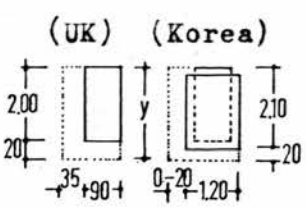
(1 person) (2 persons)

(b) Space Standards of Fittings and Activity

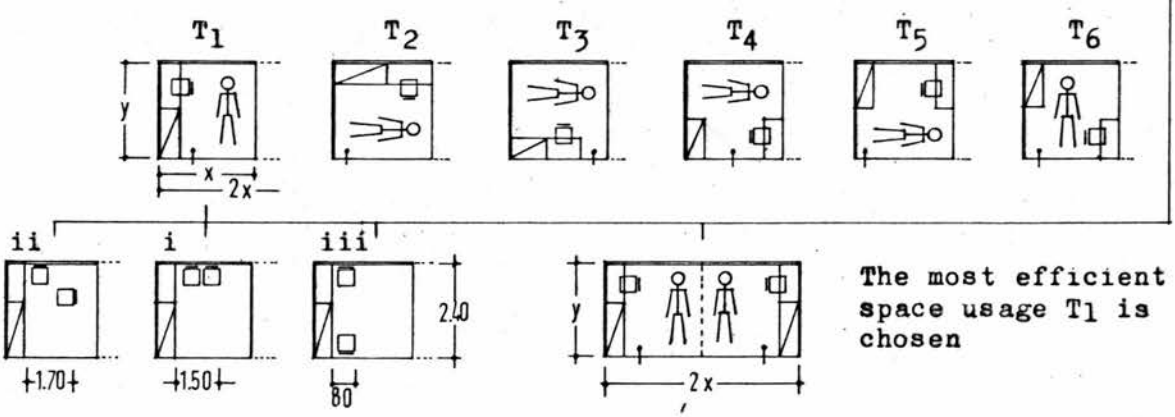
i. Fittings	(UK)	(Korea)
Bed	90 x 2.00	-
Floor bed mat	-	1.20 x 2.10
Work table	60 x 1.20	60 x 1.20
Dressing table	60 x 1.35	60 x 1.35
Length of hanging space(man)	60 x 1.10	60 x 1.10
" (woman)	60 x 1.50	60 x 1.50
Linen storage by family of five	45(60) x 95	45(60) x 95
ii. Activity space		
Working	90 x 90	90 x 90
Dressing	90 x 90	90 x 90
Making a bed	35, 20	0-20, 20
Conversation or playing(two persons)	See diagram (c)	

(Example T_1)





(c) Possible Arrangement of Fittings and Activity



Two persons' conversation or playing
Sittings: side by side;
at angle; directly opposite

Double units plan for two persons

The most efficient space usage T_1 is chosen

Result

UK	2.40≤x≤3.00,	2.45(2.40)≤y≤2.45(2.70)
Korea	1.80≤x≤2.40,	2.40≤y≤2.45(2.70)

Fig. 5.7 Evaluation Factors for Bed/Sitting Room

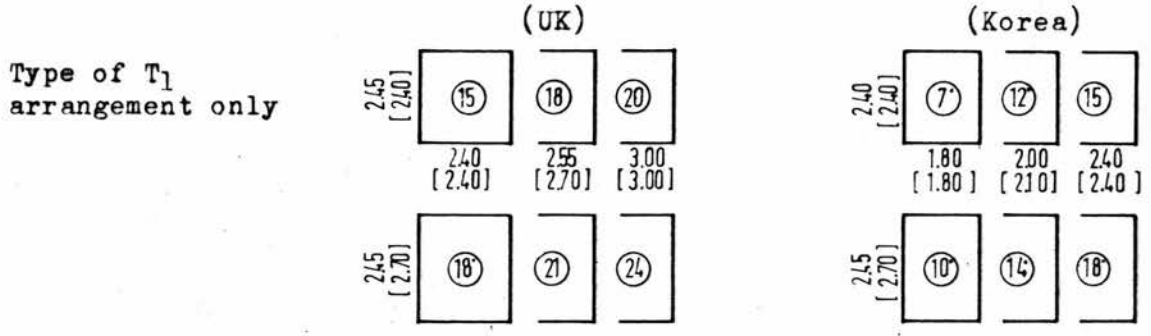
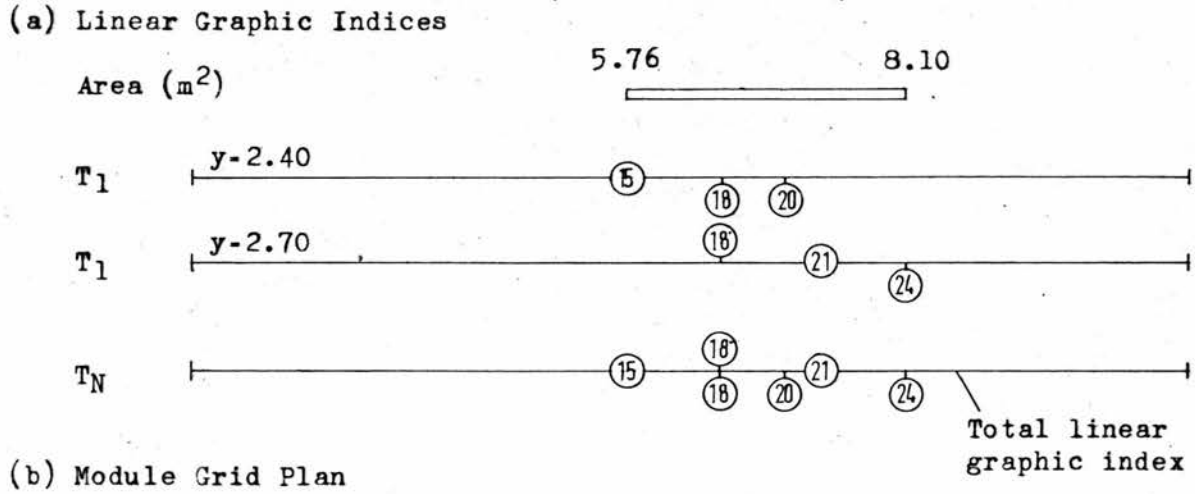
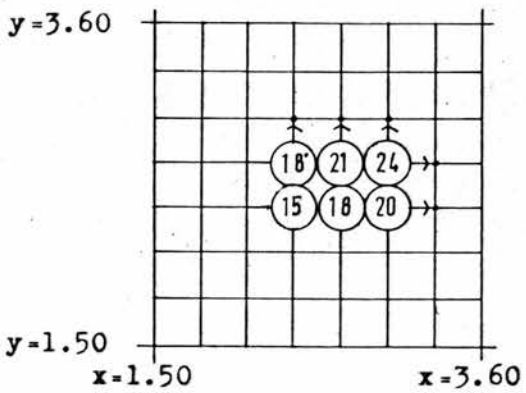


Fig. 5.8 Practical Possible Compact Bed/Sitting Rooms in Systematic Variation for the UK and Korea





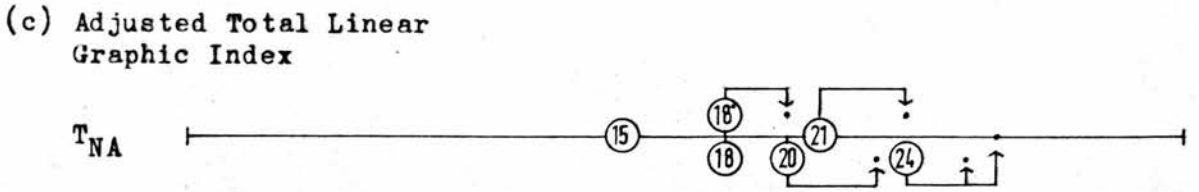
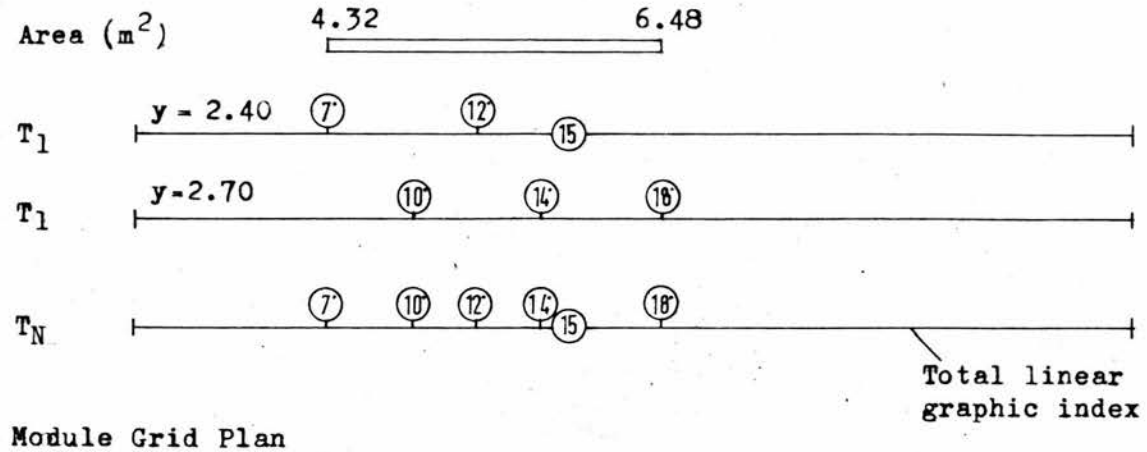
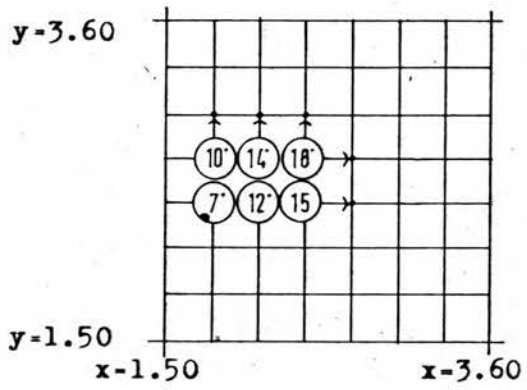


Fig. 5.9 Useful Dimensions of the Variation of Bed/Sitting Room Size Evaluated by the UK Norm

(a) Linear Graphic Indices



(b) Module Grid Plan



(c) Adjusted Total Linear Graphic Index

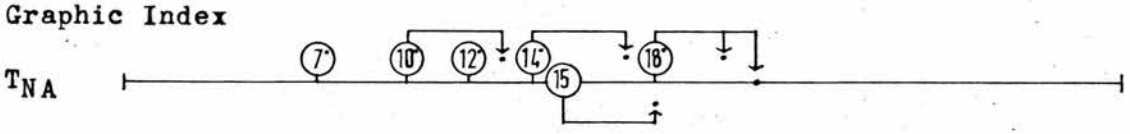


Fig. 5.10 Useful Dimensions of the Variation of Bed/Sitting Room Size Evaluated by Korean Norm

could be fitted on one side (on blind wall) of the bed/sitting room to hold the wardrobe/closet, work-table or dressing table.

Three seating arrangements for two people are also suggested in Fig. 5.7(c): (i) side by side; (ii) at an angle; (iii) directly opposite. The respective sizes required are given.

The Results

Fig. 5.8 shows the possible practical plans for a compact bed/sitting room which are produced from the evaluation factors indicated in Fig. 5.7.

The lower parts of Figs. 5.9 and 5.10 show the resulting adjusted total linear graphic index for the U.K. and Korea respectively.

4.3 Dining Room.

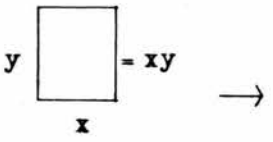
Given Factors

(i) One spatial unit is allowed for the dining room. The wall adjoining the corridor has been removed, making the dining room larger than the area of one spatial unit alone as in the case of the living room. There is an overlap of circulation space in the corridor. One or both blind walls of the dining room adjoining the kitchen or living room may be removed to create one large room if needed.

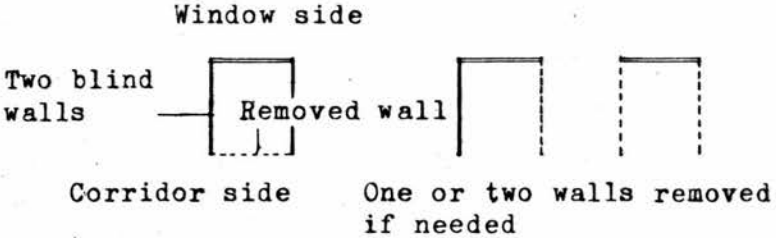
(ii) The various sizes and dimensions of the fittings and activity space for the U.K. and Korea are given as shown in Fig. 5.11(b). Dining room fittings are al-

(a) Spatial Unit and Wall Constraints

Spatial unit = xy

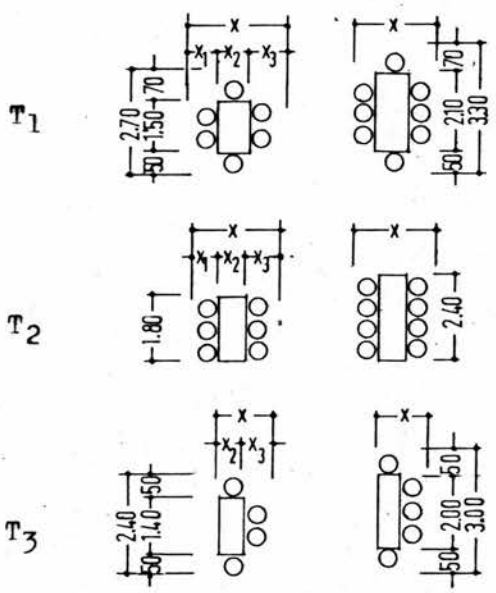


Wall constraints

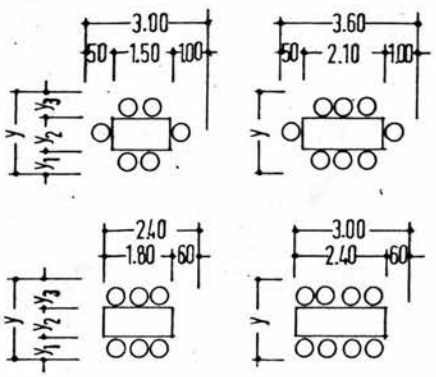


(b) Space Standards of Fittings and activity (UK/Korea, 4–8 seats, $y \geq 1.80$)

i. Vertical arrangement (T)



ii. Horrizontal arrangement (T')



(c) Dimensions

Column x_1 and y_3 are including a circulation space around the table.
Column x_3 is the space needed for service to the table.

	(x_1)	(x_2)	(x_3)	(x)
T_1	50+(35)	90	50+(75)	3.00
	50+(35)	90	50+(35)	2.60
	50+(0)	90	50+(35)	2.25
	50+(0)	90	50+(0)	1.90
T_2	50+(35)	75	50+(75)	2.85
	50+(35)	75	50+(35)	2.45
	50+(0)	75	50+(35)	2.10
	50+(0)	75	50+(0)	1.75
T_3		75	50+(60)	1.85

	(y_1)	(y_2)	(y_3)	(y)
T'_1	50	90	50+(35)	2.25
	50	90	50+(0)	1.90
T'_2	50	75	50+(35)	2.10
	50	75	50+(0)	1.75

Results

UK/Korea $1.75(1.80) \leq x \leq 3.00$
$1.80 \leq y \leq 3.30$

UK/Korea $2.40 \leq x \leq 3.60$
$1.75(1.80) \leq y \leq 2.25(2.40)$

Fig. 5.11 Evaluation Factors for Dining Room

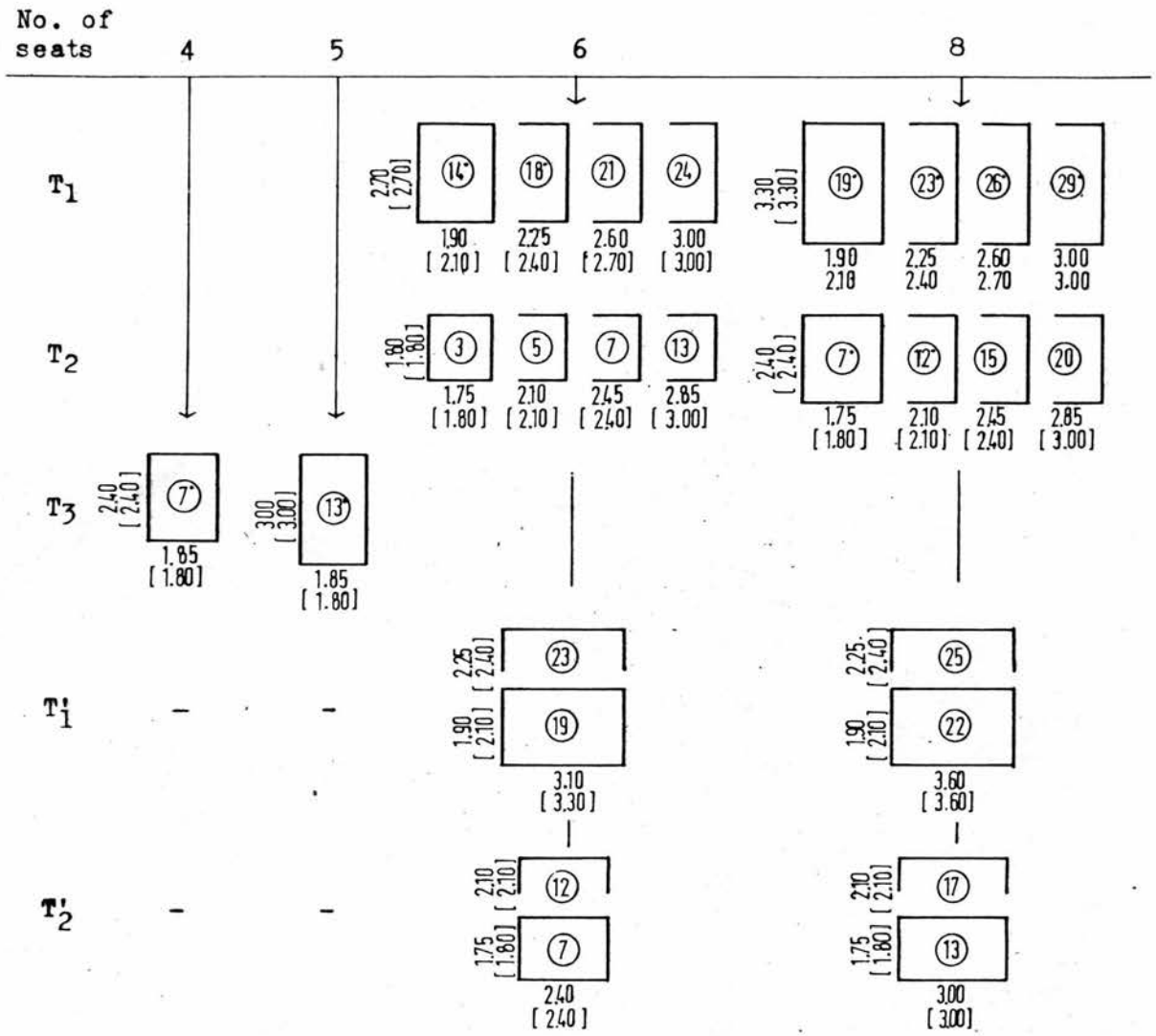
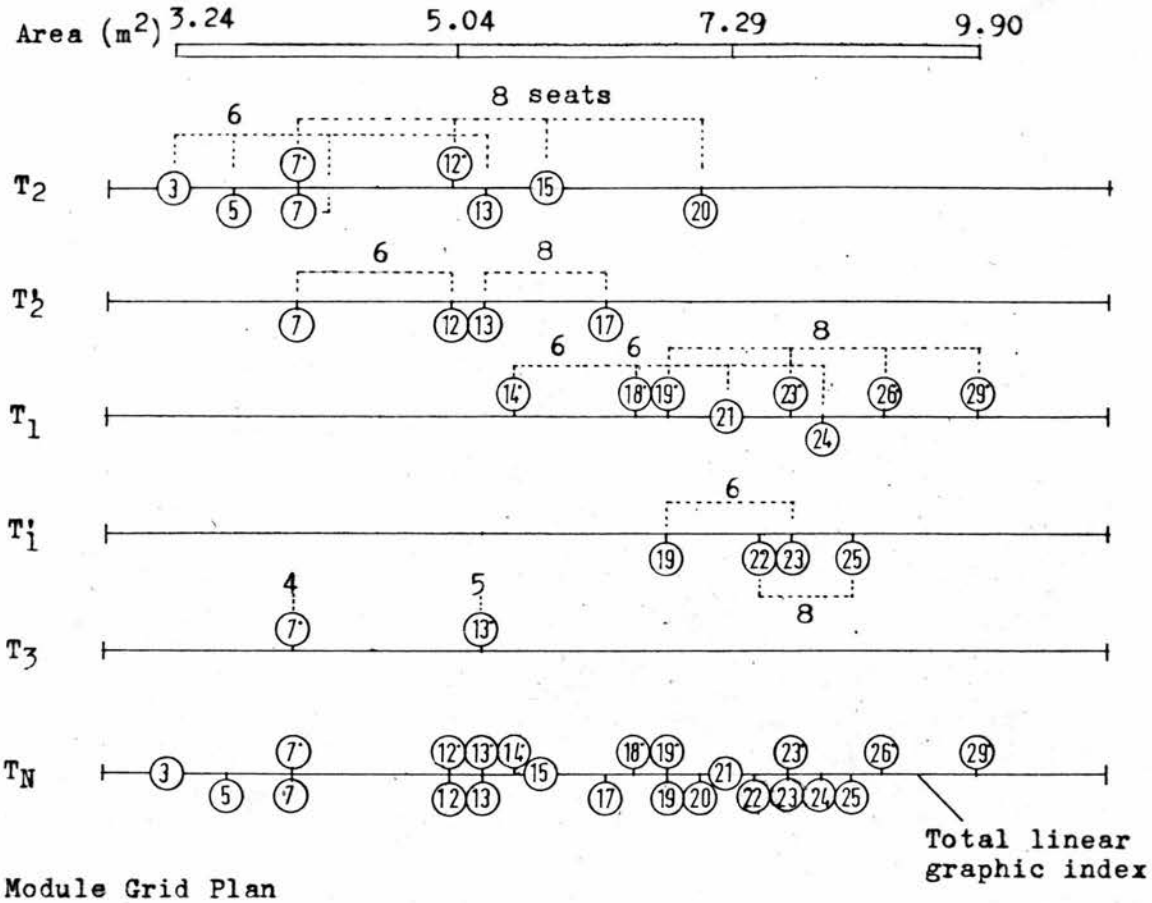
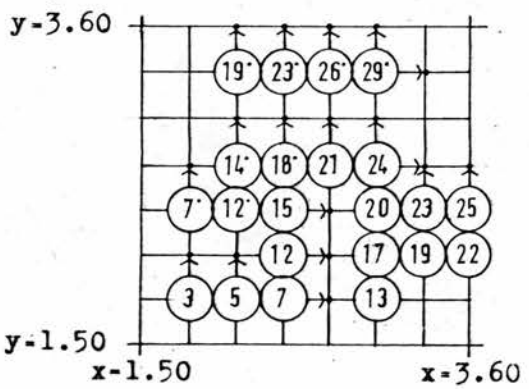


Fig. 5.12 Practical Possible Compact Dining Room in Systematic Variation

(a) Linear Graphic Indices



(b) Module Grid Plan



(c) Adjusted Total Linear Graphic Index

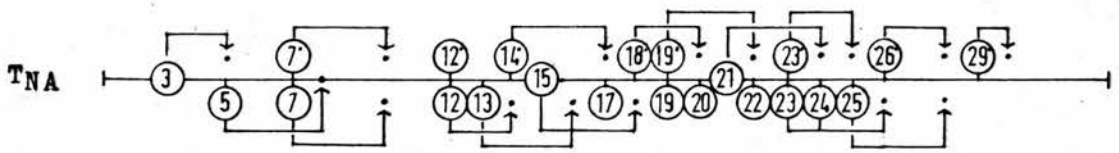


Fig. 5.13 Useful Dimensions of the Variation of Dining Room Size Evaluated by the UK and Korean Norms

most the same size in both countries. There are two arrangements for the table: parallel to the blind wall (T_1, T_2 ··) and at right angles to the blind wall (T'_1, T'_2 ···). The number of chairs ranges from 4 to 8.

There are five possible arrangements (which must be x or y $\geqslant$1.8m) for T and T' as shown in Fig. 5.11(c), some of which permit free circulation around the table, and others which limit circulation.

The Results

All of these factors produce a feasible compact dining room plan with a 0.3m increment on the grid plan. Fig. 5.12 shows the relationship between the number of seats, type of arrangement.

The required 'series number' (N or N') on the linear graphic index for the arrangement of T and T' is shown in Fig. 5.13(a). All the numbers and adjusted numbers which result are shown on the modular grid plan and the adjusted total linear graphic index (T_{NA}) in Figs. 5.13(b) and (c).

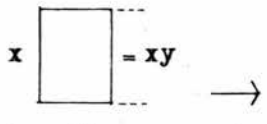
4.4 Kitchen.

Given Factors

(i) One spatial unit is allowed for the kitchen. The decision to include or omit space for main meals will usually determine the type of kitchen produced. Some people prefer to eat in the kitchen but others prefer a separate dining room to reduce cooking smells. This thesis has not covered the kitchen/dining room

(a) Spatial Unit and Wall Constraints

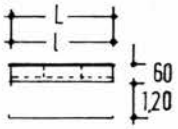
Spatial unit



Wall constraints

Window side

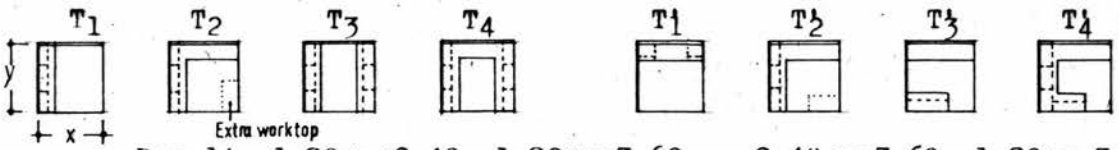
(b) Space Standards of Fittings and Activity (UK/Korea)



Worktop length(L) Wall unit shelves length(l)
Clearances(C) Work triangle(A)

$3.60 \leq L \leq 4.50(5.20)$, $C \geqslant 1.20$, $l \geqslant 3.30$, $A \leq 6.60$

(c) Arrangement and Result



Result $1.80 \leq x \leq 2.40$, $1.80 \leq y \leq 3.60$ $2.40 \leq x \leq 3.60$, $1.80 \leq y \leq 3.30$

(d) Practical Possible Compact Plans in Systematic Variation

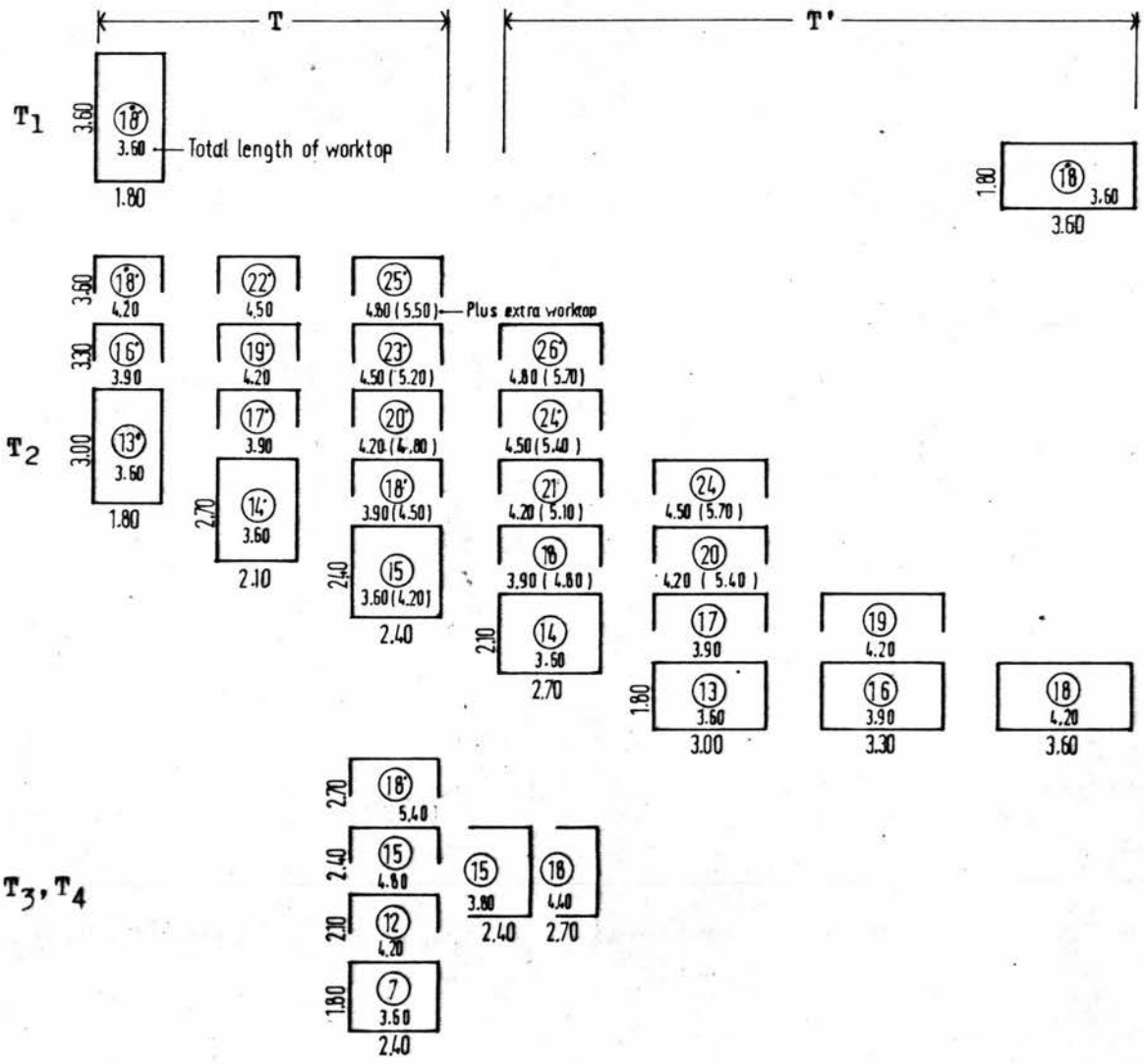
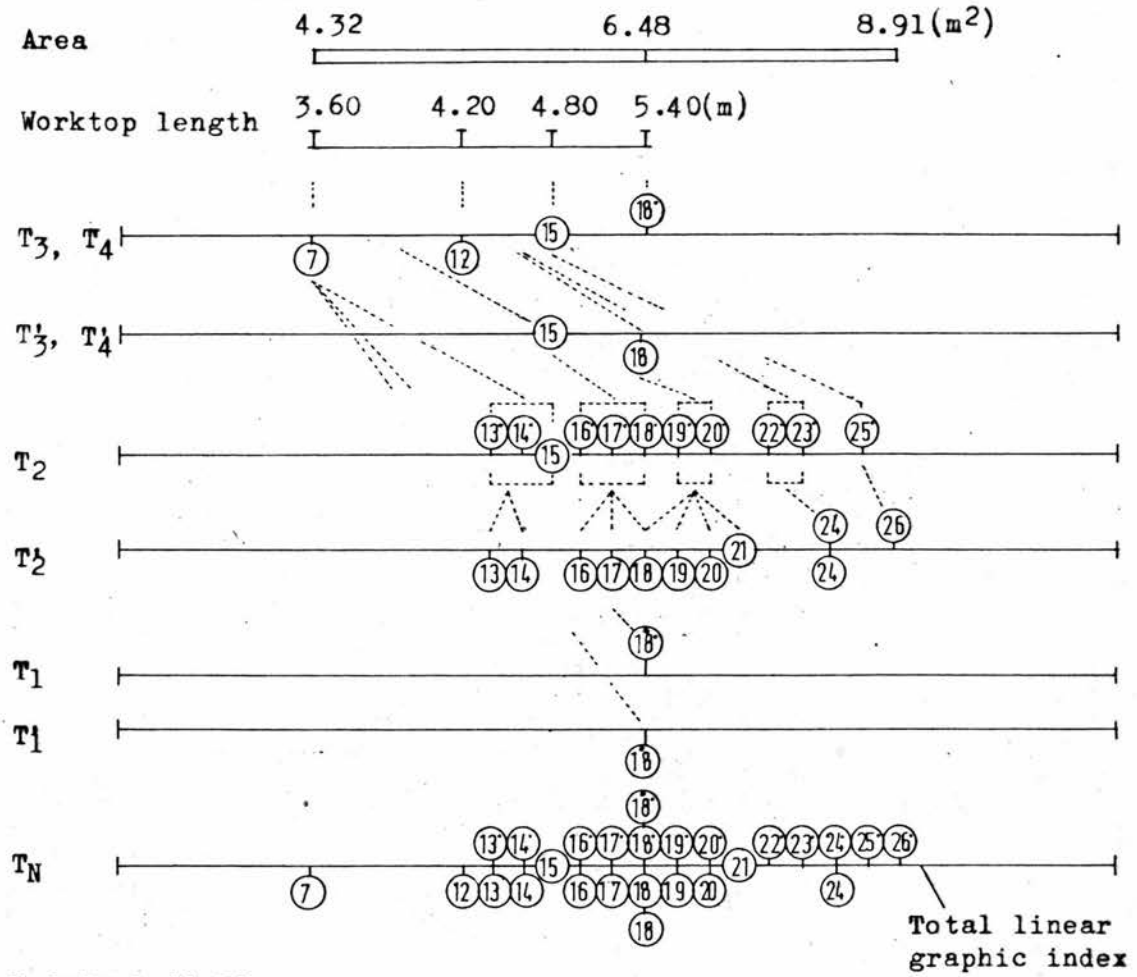
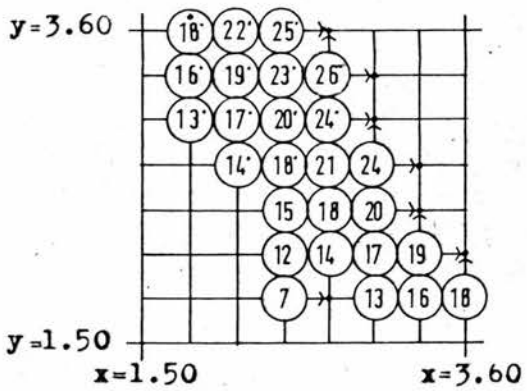


Fig. 5.14 Evaluation Factors for Kitchen, and Practical Possible Compact Plans in Systematic Variation

(a) Linear Graphic Indices



(b) Module Grid Plan



(c) Adjusted Total Linear Graphic Index

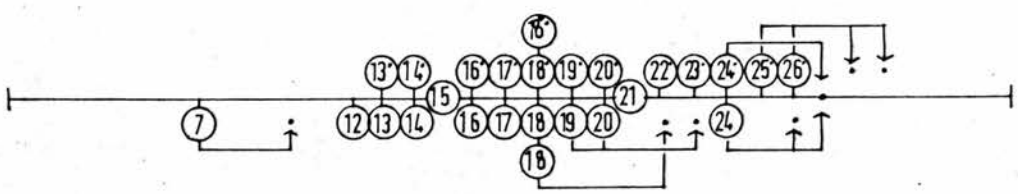


Fig. 5.15 Useful Dimensions of the Variation of Kitchen Size Evaluated by the UK and Korean Norms

concept but suggests a dining room adjacent to the kitchen, so one or two walls of the kitchen are removable in order to join it together with the adjacent dining room if needed, as shown in Fig. 5.14(a). The designer should also decide what provision for laundry should be made, but whether or not any other activities (such as the supervision of children's play) take place in the kitchen, will depend on the space available and individual preference.

(ii) The various sizes and dimensions of the fittings and activity space for the U.K. and Korea are given as shown in Fig. 5.14(b). Kitchen fittings are almost the same size in both countries. There are four basic types of worktop arrangements: I, L, double I, and U shapes. Overlap space usage occurs in all except 'I'. There is least overlap in 'L' with 'U' having the most. The recommended worktop length for the U.K. is 4.5m[1], but also a minimum length of 3.6m. is given.[2] The suggested length for Korea is 3.6m.

The Results

These factors result in a compact kitchen plan with 0.3m increment on the grid plan. Fig. 5.14 shows the relationship between the two norms, four basic types of arrangement and worktop length. All required series numbers and adjusted numbers which result are shown on the modular grid plan and the total linear graphic index in Fig. 5.15.

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1. Department of the Environment, Spaces in the Home (Kitchen's and Laundry Spaces), 1972, p. 20.

2. L. Fairweather and J. A. Sliwa, A.J. Metric Handbook, 1971. p. 140.

4.5 Bathroom/W.C.

Given Factors

Again one spatial unit is allowed for the bathroom/W.C. which will contain a bath, washhand basin, lavatory and a hot water tank. These fittings are the same size in both the U.K. and Korea. Fig. 5.16 gives the British standards[1] for these fittings plus activity space, and also sizes for Korea. The Korean sizes are not nationally established standards. Ten possible arrangements for the fittings are presented in Fig. 5.16, of which nine have a bath, washhand basin and W.C. All of these arrangements include a hot water tank, although its location varies in different plans. It is preferable to position it on a blind wall where it will be near certain other rooms (kitchen, utility or laundry) which also require plumbing and so reduce costs.

In each case considered, there is some degree of overlap space. This, together with the arrangement of fittings affect the room size and dimension.

The Results

All of these factors produce a feasible compact bathroom/W.C. plan with a 0.3m. increment on the grid plan. Fig. 5.16-d shows the Nine types of arrangement. The required series numbers on the linear graphic index are shown in Fig. 5.17. All the numbers and adjusted numbers which result are shown on the modular grid plan and adjusted total linear graphic index (T_{NA}) in Figs. 5.17(b), and (c).

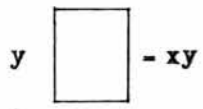
---

1. Department of the Environment, Spaces in the Home (Bathrooms and W.C.'s), 1972

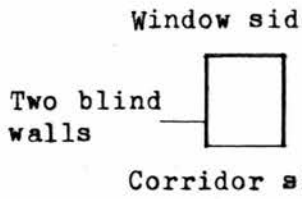
   International Organization for Standardization (ISO), Space Requirements for Sanitary Appliances, 1972.

(a) Spatial Unit and Wall Constraints

Spatial unit

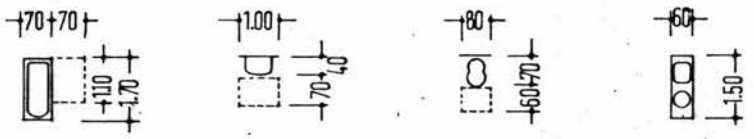


Wall constraints



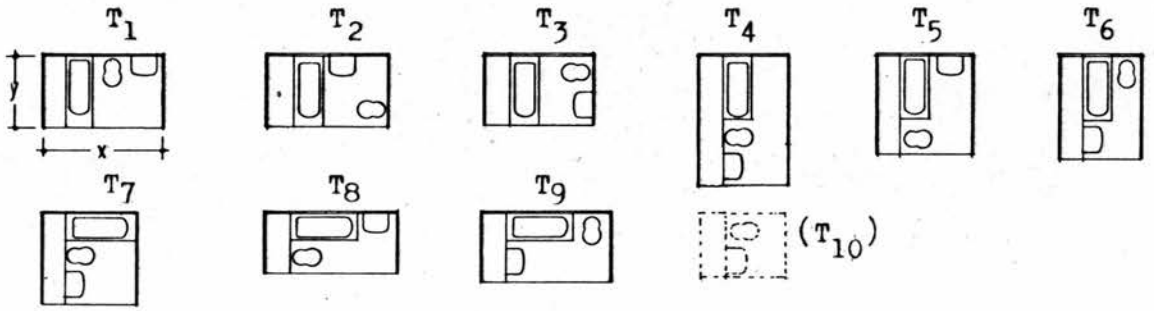
(b) Space Standards of Fittings and Activity(UK/Korea)

The bath. The washbasin. The WC. The hot water cylinder and water tank



(c) Arrangement and Result

Arrangement



Result 2.10≤x≤3.30, 1.50≤y≤3.30

(d) Practical Possible Compact Plans in Systematic Variation

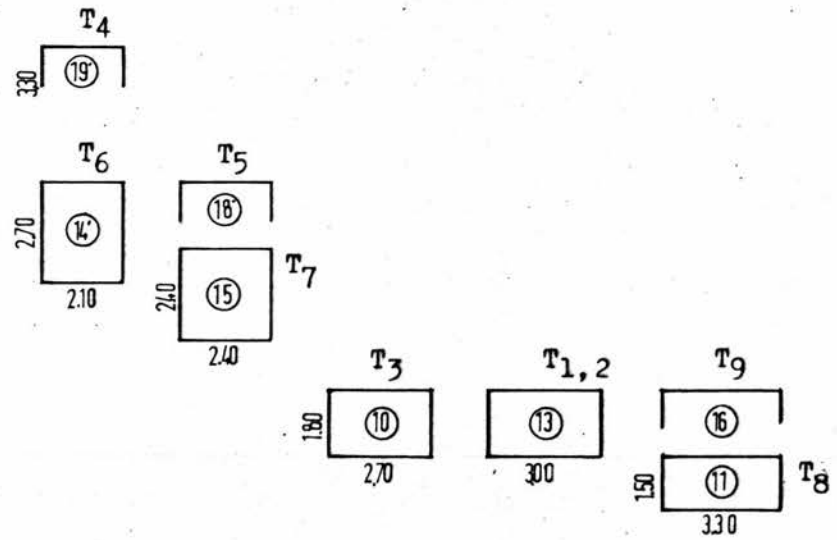
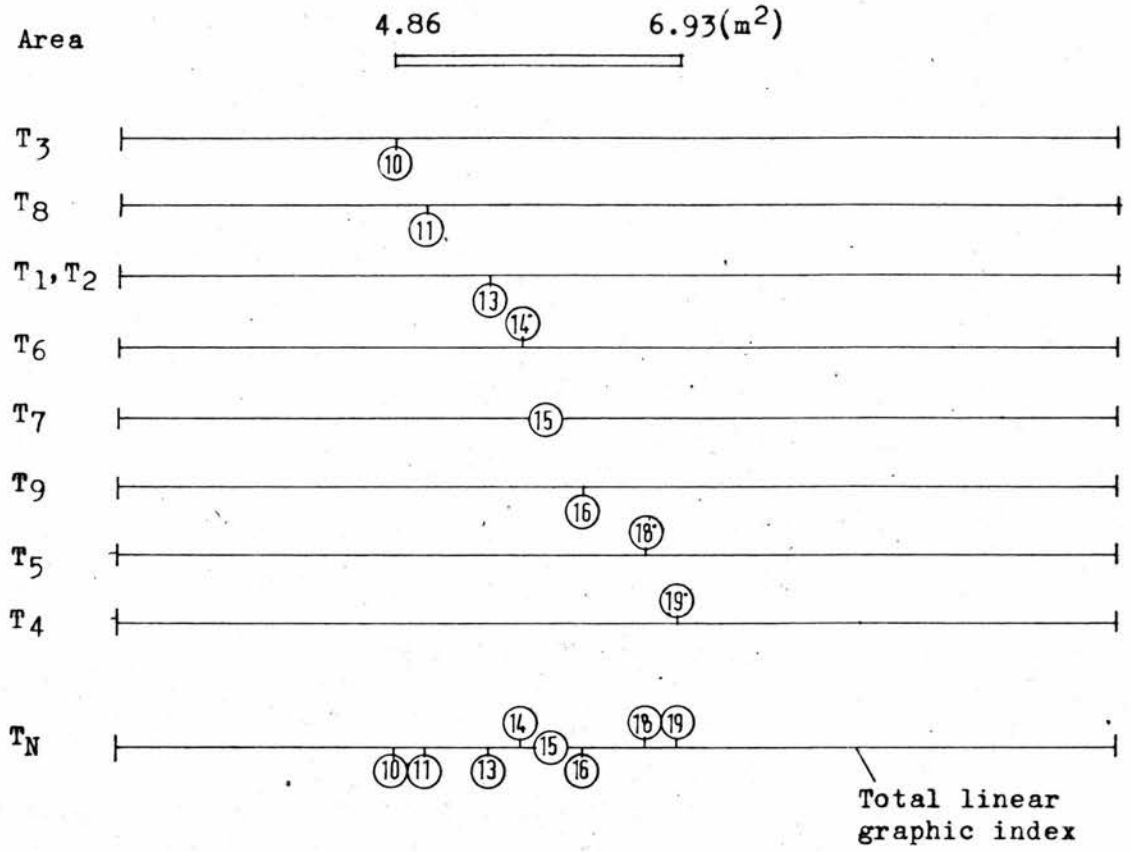
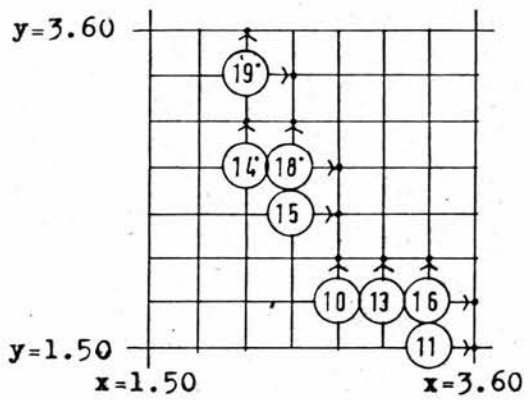


Fig. 5.16 Evaluation Factors for Bathroom/WC., and Practical Possible Compact Rooms in Systematic Variation

(a) Linear Graphic Indices



(b) Module Grid Plan



(c) Adjusted Total Linear Graphic Index

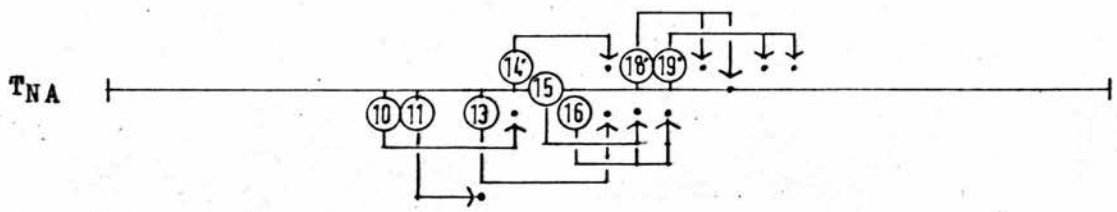


Fig. 5.17 Useful Dimensions of the Variation of Bathroom/WC. Size Evaluated by the UK and Korean Norms

4.6 Entrance Hall.

Given Factors

Again, one spatial unit is allowed for the entrance hall, which has only two blind walls as the front entrance is at one end and the corridor at the other. Spatial and fitting requirements are the same in the U.K. and Korea, except that in Korea a small platform is needed to assist people in removing their shoes. There must be enough room in the hall to allow people to put on coats and also to receive visitors at the door. Two plans for the hall are given in Fig. 5.18(b). The first shows space for having coats on one side of the hall only and the second has cloak-room space on either side. The choice depends on the area and shape of the hall. A total length of 3.6 - 5.4m. is required for hanging clothes, etc.

The Results

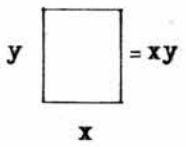
These factors produce a practical compact entrance hall plan with a 0.3m. increment on the grid plan. Fig. 5.18(c) shows the three types of arrangement. All the numbers and adjusted numbers which result are shown in the modular grid plan and adjusted total linear graphic index in Figs. 5.19 (b) and (c).

4.7 Other Rooms.

Into this category come the utility room, the extra living room, which can be used as a children's playroom (a 'den') if required, and a spare room which can be made into an extra bedroom or second dining room as needed. No

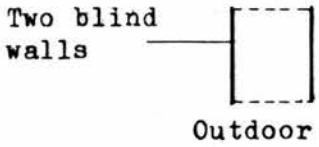
(a) Spatial Unit and Wall Constraints

Spatial unit

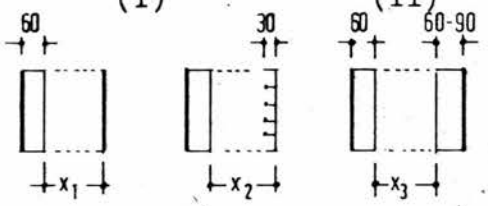


Wall constraints

Corridor side



(b) Space Standards of Fittings and Activity (UK/Korea)



$1.20 \leq x_1$

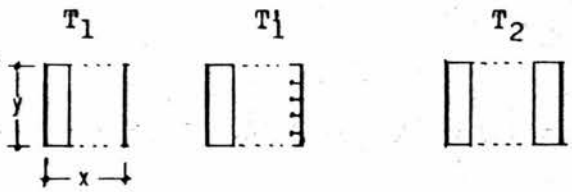
$1.50 \leq x_2,\ x_3$

Total length of cloakroom and storage(L)

$3.60 \leq L \leq 5.40$

(c) Arrangement and Result

Arrangement



Result

$1.80 \leq x \leq 3.00$

$1.50 \leq y \leq 3.60$

(d) Practical Possible Compact Plans in Systematic Variation

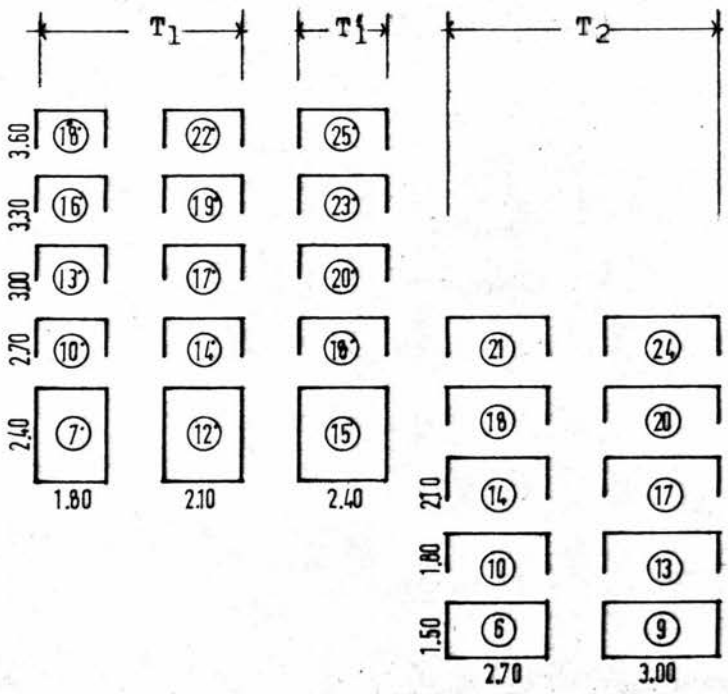
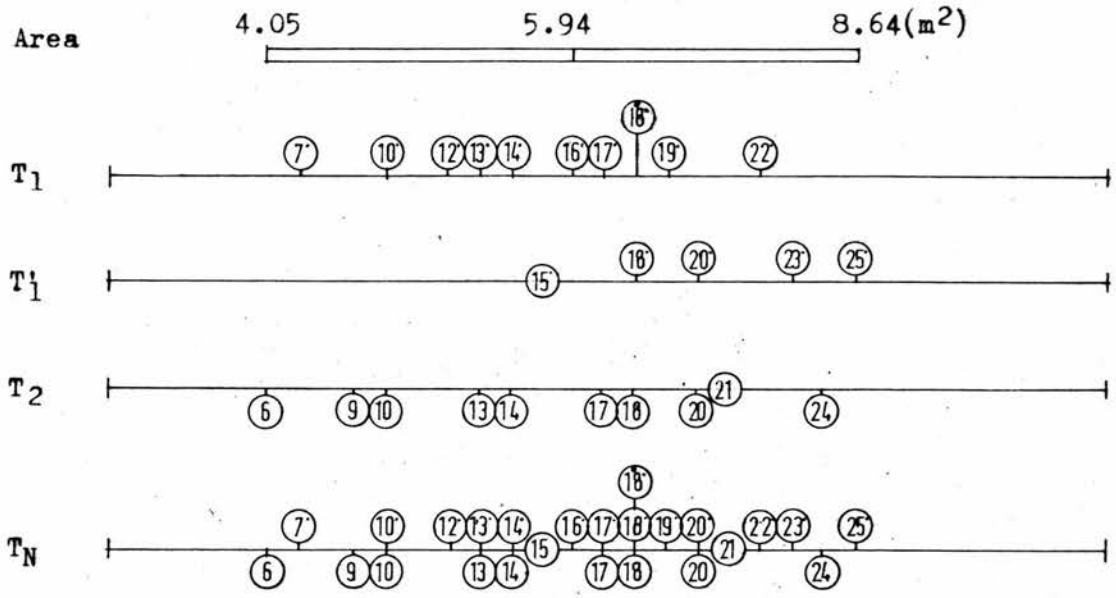
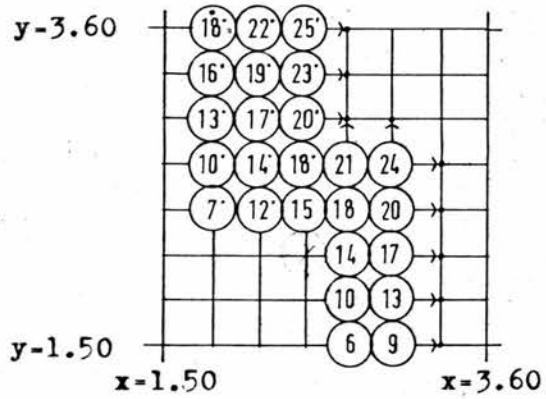


Fig. 5.18 Evaluation Factors for Entrance Hall and Practical Possible Compact Plans in Systematic Variation

(a) Linear Graphic Indices



(b) Module Grid Plan



(c) Adjusted Total Linear Graphic Index

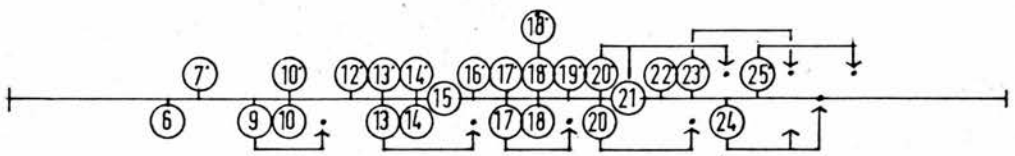


Fig. 5.19 Useful Dimensions of the Variation of Entrance Hall Size Evaluated by the UK and Korean Norms

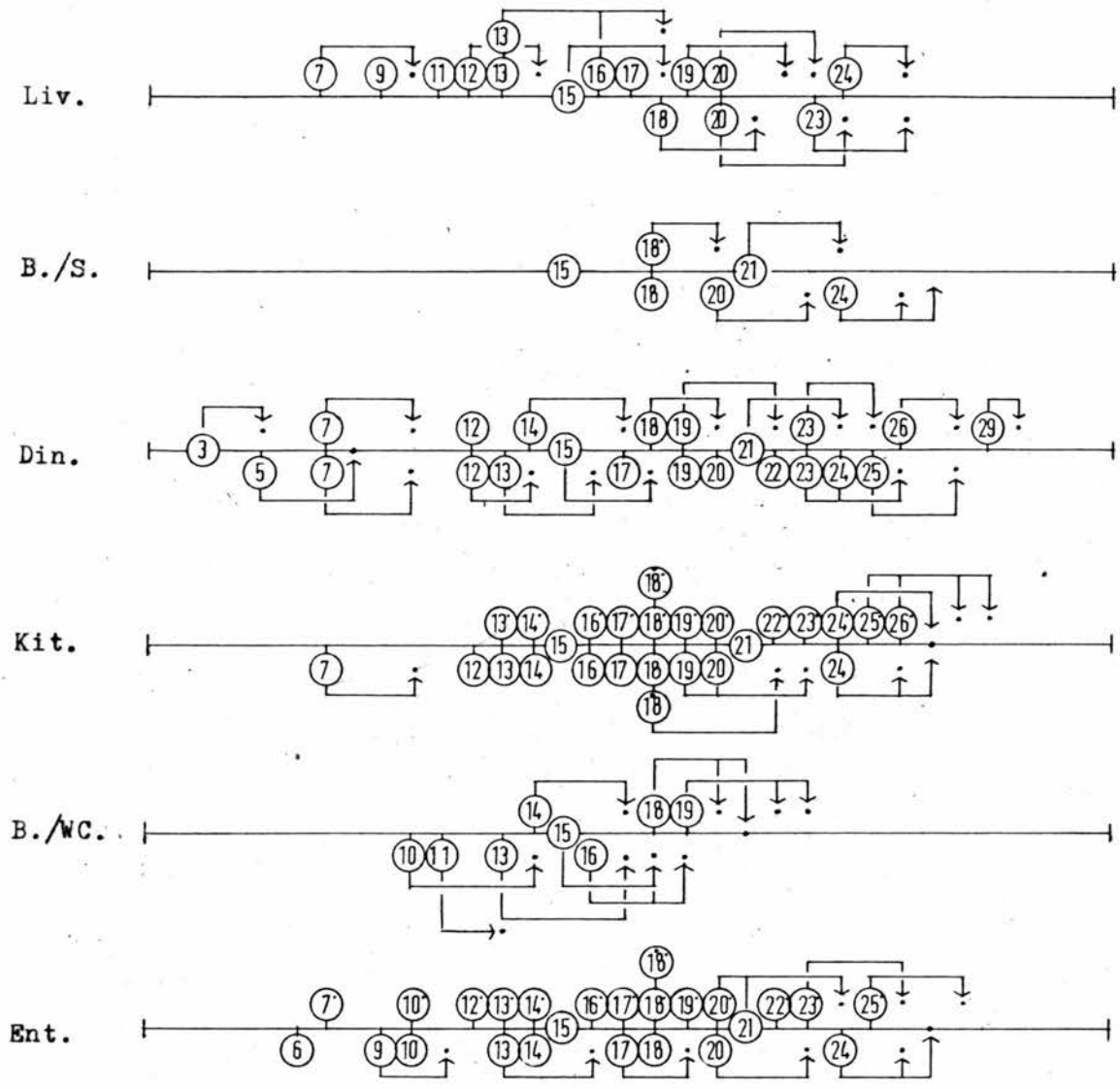
evaluation factor is considered for these rooms as they are created by the extra space in the framework after the dimensions for the main room have been found. These rooms are all allowed one spatial unit each except for the children's living room which has two.

5. ADJUSTMENT OF THE COMMON AREA AND DIMENSION OVER ROOM.

A common area and dimension for all the rooms is needed to enable interchange of rooms (spatial units). The possibilities are investigated by comparing the numbers of the adjusted total linear graphic index. The result of this comparison is shown on the final linear graphic index in Figs. 5.20(b) for the U.K. and 5.21(b) for Korea. On this final index, the results of the analysis for each individual room may be summed up to indicate a score for each series number, the highest score being six. This score is a measure of the efficiency of interchangeability for the size and dimension of the spatial unit. If six is not possible the next best score is five, and so on in a descending fashion. Fig.5-22(a) and (b) show the modular grid plan for the U.K. and Korea taken from the score indicators in Figs. 20 and 21. Fig.5-22(a) shows the recommended usable dimensions for the U.K. which lie between 2.4 and 2.7m for x and y. Of this, the most suitable is $\bar{x}$ = 2.4m, $\bar{y}$ = 2.4m (N = 15). In the case of Korea, shown in (b), the recommended range is from x = 1.8 - 2.4m, y = 2.4 - 2.7m. The most suitable is $\bar{x}$ = 2.4m and $\bar{y}$ = 2.4m.

When these are compared on the same diagram (c), a limited range of suitable dimensions is produced. Within this range (x = 1.8 - 2.4m) the most suitable dimension for both countries is $\bar{x}$ = 2.4m, $\bar{y}$ = 2.4m, but Korea, having slightly lower space standards, takes in the lower part of the range while the U.K. sizes extend to x = 2.7m. Thus there is more variation in the x axis than in the y axis.

(a) Comparison of the Adjusted Total Linear Graphic Indices



(b) Final Linear Graphic Index

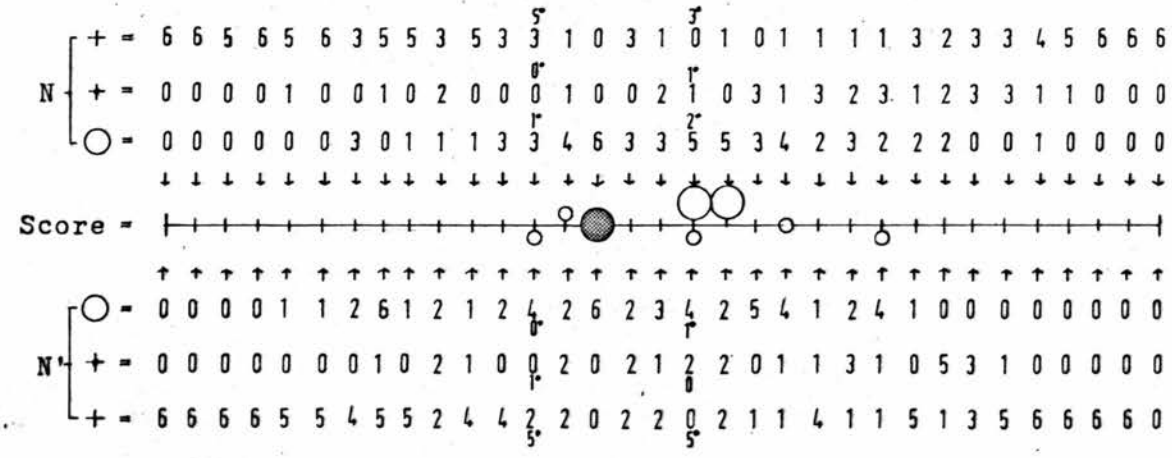
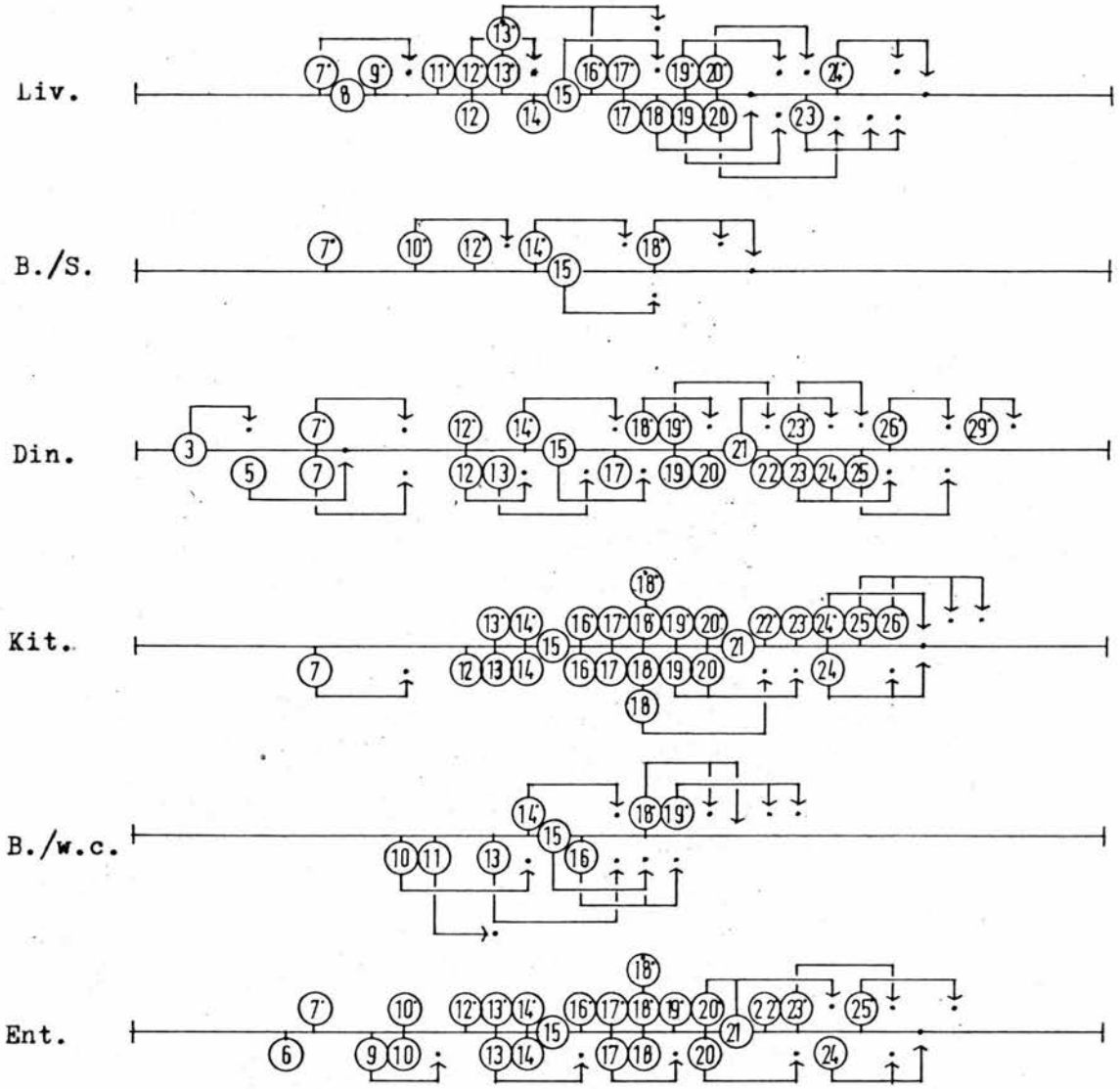


Fig. 5.20 The Final Linear Graphic Index for the UK's Standards

(a) Comparison of the Adjusted Total Linear Graphic Indices



(b) Final Linear Graphic Index

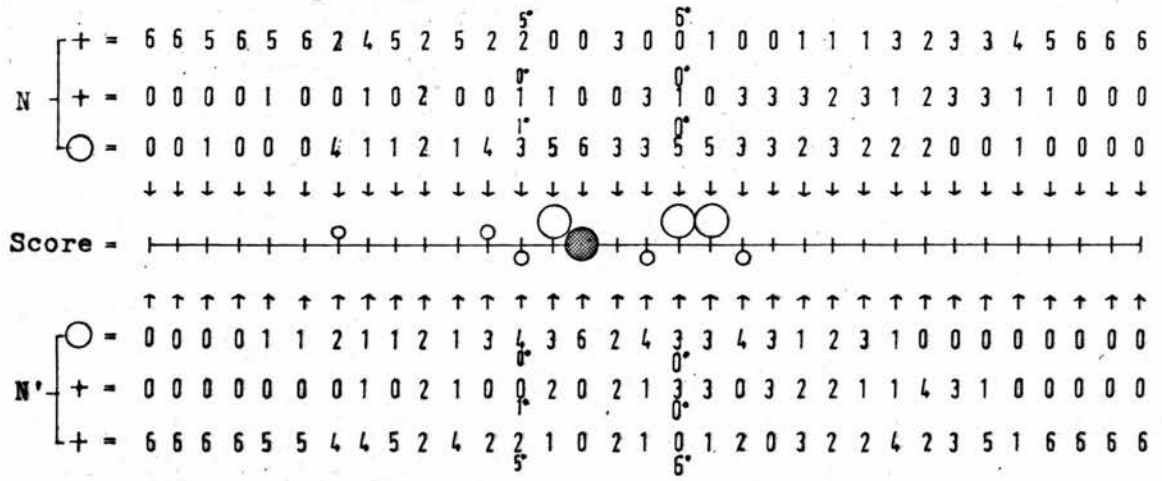
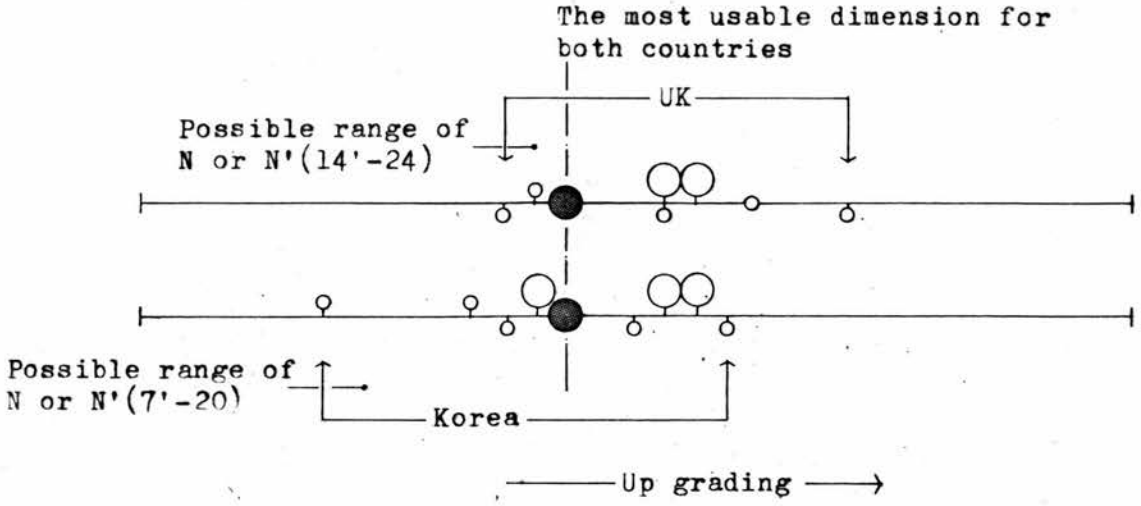


Fig. 5.21 The Final Linear Graphic Index for Korean Standards

(a) Comparison of the Final Linear Graphic Indices for the UK's and Korean Standards



(b) Comparison of the Module Grid Plans for the UK and Korea

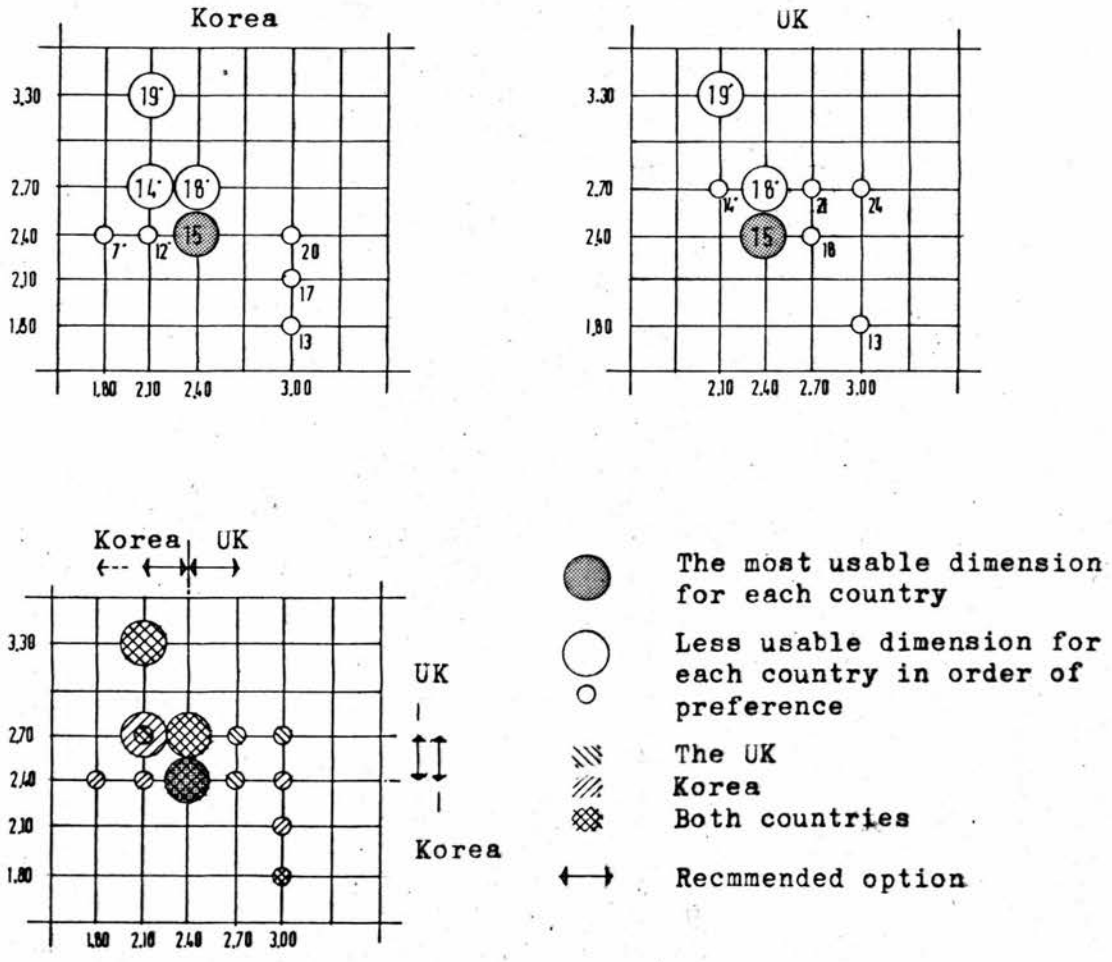


Fig. 5.22 Common Usable Area and Dimension for Each Individual Room According to Priority

In terms of the variation of the Korean space standard, it could be said that the minimum is also x = 2.4m, y = 2.4m which is shown in the grid plan as N = 15. It also can be varied gradually from N = 7 to 18 ' on the comprehensive grid plan. Diagram 5.22(c) shows a comparison between the minimum space standard for the U.K., and space preferences in Korea.

The following Chapter deals only with dimensions within this range appropriate to the generation of the house plan.

6. SUMMARY AND CONCLUSIONS.

From the brief review and analysis given above for each individual room, it is clear that room sizes and configuration are interdependent. The evaluation factors are considered as follows:-

(i) The kind of functional activity to be performed in the room.

(ii) The number of occupants to be accommodated.

(iii) The desirable dimensions of room's depth.

(iv) The kind of fittings and their space standards.

(v) The arrangement of the room fittings.

(vi) The constraint of the room situation such as location of the openings in the enclosing walls (All rooms have sliding doors and in the case of the living rooms and dining rooms, certain walls have been removed to save space by overlap of circulation space).

(vii) The dimensional increment of modular co-ordination on a grid plan.

The common dimension and size for all the rooms within the minimum margin increment may be obtained from an evaluation of the comprehensive linear graphic index of each individual room as shown in Fig. 5.20.

According to this result, the common dimension of the compact room size as an interchangeable spatial unit in terms of the U.K's space standards could be said to be $\bar{x}$ = 2.4m, $\bar{y}$ = 2.4m, indicated on the grid plan as number of N = 15 on a linear graphic index. However, we can choose another dimension or size by gradual increments along the grid starting from N = 15 until 21 as shown in Fig. 5.22(b).

CHAPTER VI

THE GENERATION OF THE ADAPTABLE HOUSE PLAN

1. INTRODUCTION.
2. POSSIBLE OVERALL PLAN IN METRIC SHELL.
3. REASONS BEHIND PREFERENCES FOR ARRANGEMENT OF ROOMS.
4. SOME EXAMPLES OF THE GENERATION OF ADAPTABLE HOUSE PLANS.
5. GENERATION OF MINIMUM PLOT LAYOUT.
6. SUMMARY AND CONCLUSIONS.

1. INTRODUCTION.

This chapter covers the generation of the house plan with regard to information investigated previously concerning compactness in the 'Metric Shell'. It includes an investigation of the available range of dwelling sizes using agreed values for the factors of household size and functional segregation, for both the U.K. and Korea. Attention is given to the possibility of adapting the plan as Q (number of spatial units) changes.

Generally accepted topological arrangements, plus freedom of choice of arrangement for the user within the frame plan, result in the generation of the house plan. To facilitate design, some guidelines for established practice in Korea and the U.K. are given.

Further analysis gives the resulting plot sizes after the house plan has been established.

2. POSSIBLE OVERALL HOUSE PLAN IN METRIC SHELL.

This section deals with the available range of dwelling sizes and the metric shell using a given variation for Q, for both the U.K. and Korea. Fig. 6.1 shows the relationship between household size, plus degree of functional segregation, giving the number of spatial units required (Q), the dwelling area (D) and the x, y dimension of the basic spatial unit as studied in the previous chapter. Variations of the x dimension (x = 1.8, 2.1, 2.4 and 2.7m) are set against two values of y; on the left hand side of Fig. 6.1, y = 2.4m, and on the right hand side y = 2.7m.

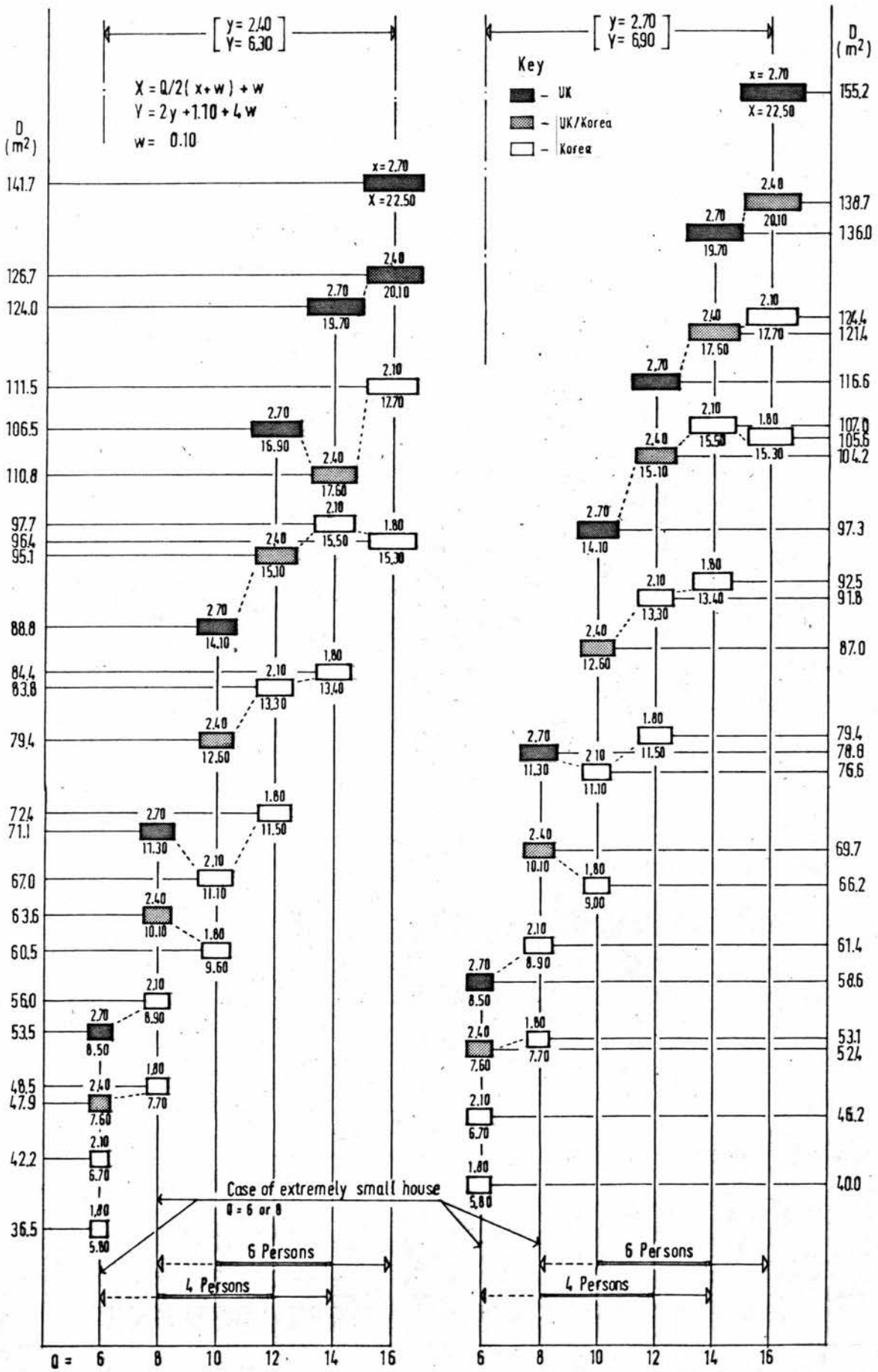


Fig. 6.1 Possible Overall House Plan in Metric Shell

The dwelling area (D) is calculated assuming a net corridor width of 1.1m, outer wall thickness of 0.2m and an internal wall thickness of 0.1m.

Fig. 6.2 shows the adaptability of the plan if a change in Q requires it. The upper part of Fig. 6.2 summarizes the analysis in Fig. 6.1 regrouping in vertical lines, the plans shown connected there, by a broken line. In each of these groups, there is little difference in frontage, and the largest dimension, X_A, is taken to represent each group. The table below this part of Fig. 6.2 shows frontages (X_A), adjusted dwelling area (D_A) and configuration ratios ($X/_Y$) of the range of house plans. The lower part of Fig. 6.2 illustrates the adaptable spatial frame plans in detail and indicates the percentage of extra area that would be needed for the largest dimension; the adaptable plan is able to cope with this difference in area quite satisfactorily.

These figures are given in more detail in Fig. 6.3. In Figs. 6.3-1 and 6.3-2 the horizontal broken line represents an extremely small house, without any dining room or common area. The double line between Q = 8 - 12 for 4 persons or Q = 10 - 14 for 6 persons represents the average U.K. house and the single line allows for possible higher space standards (for example, the provision of a children's living room). From these figures can be found the smallest dwelling area and also the largest allowing adaptability according to a given value of Q, x and y.

For example Q = 10 (i.e. lowest degree of functional segregation for six persons), x = 2.4 and y = 2.4 (i.e. both are the smallest dimension for the U.K.) ∴ dwelling area 84.4m^2.

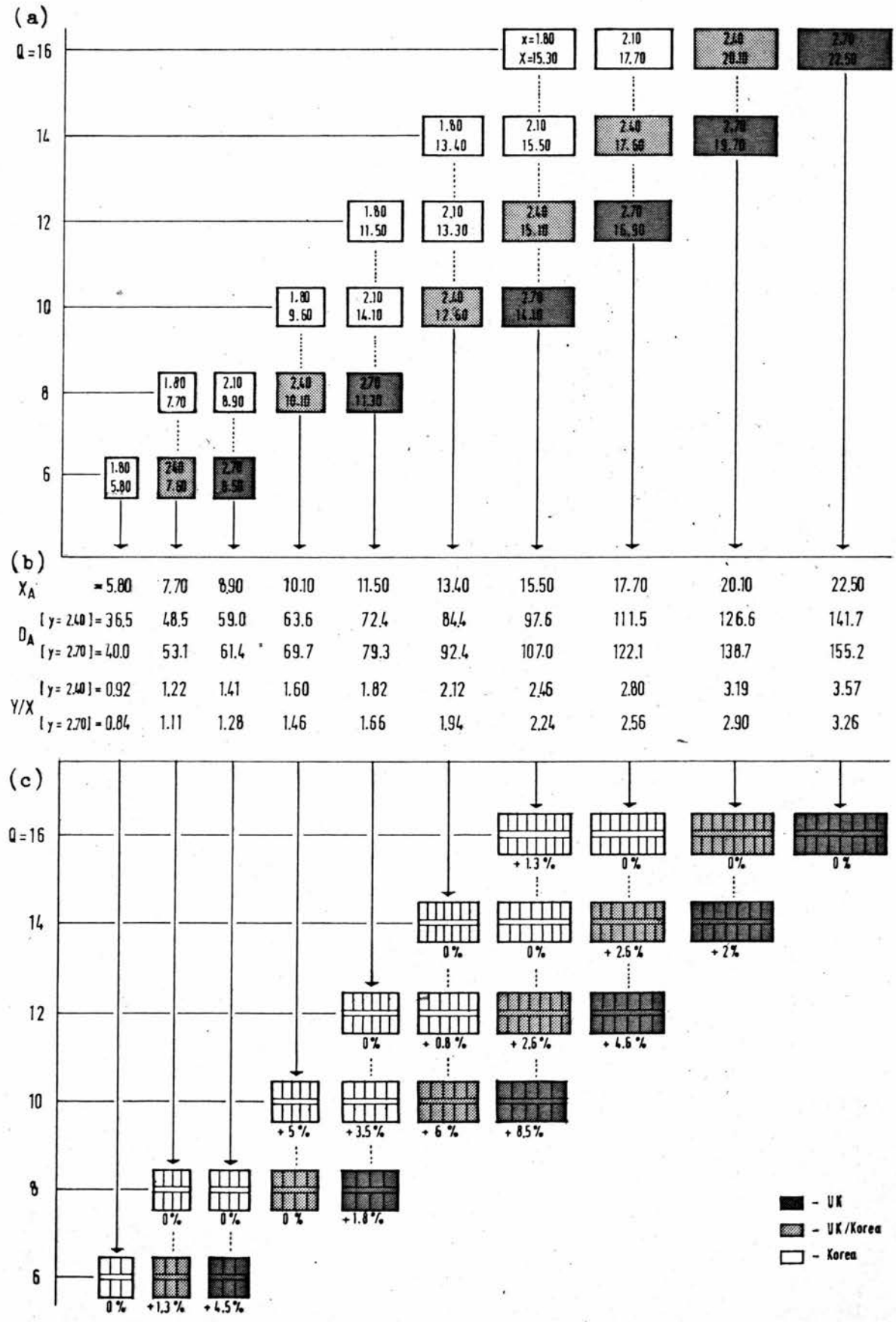
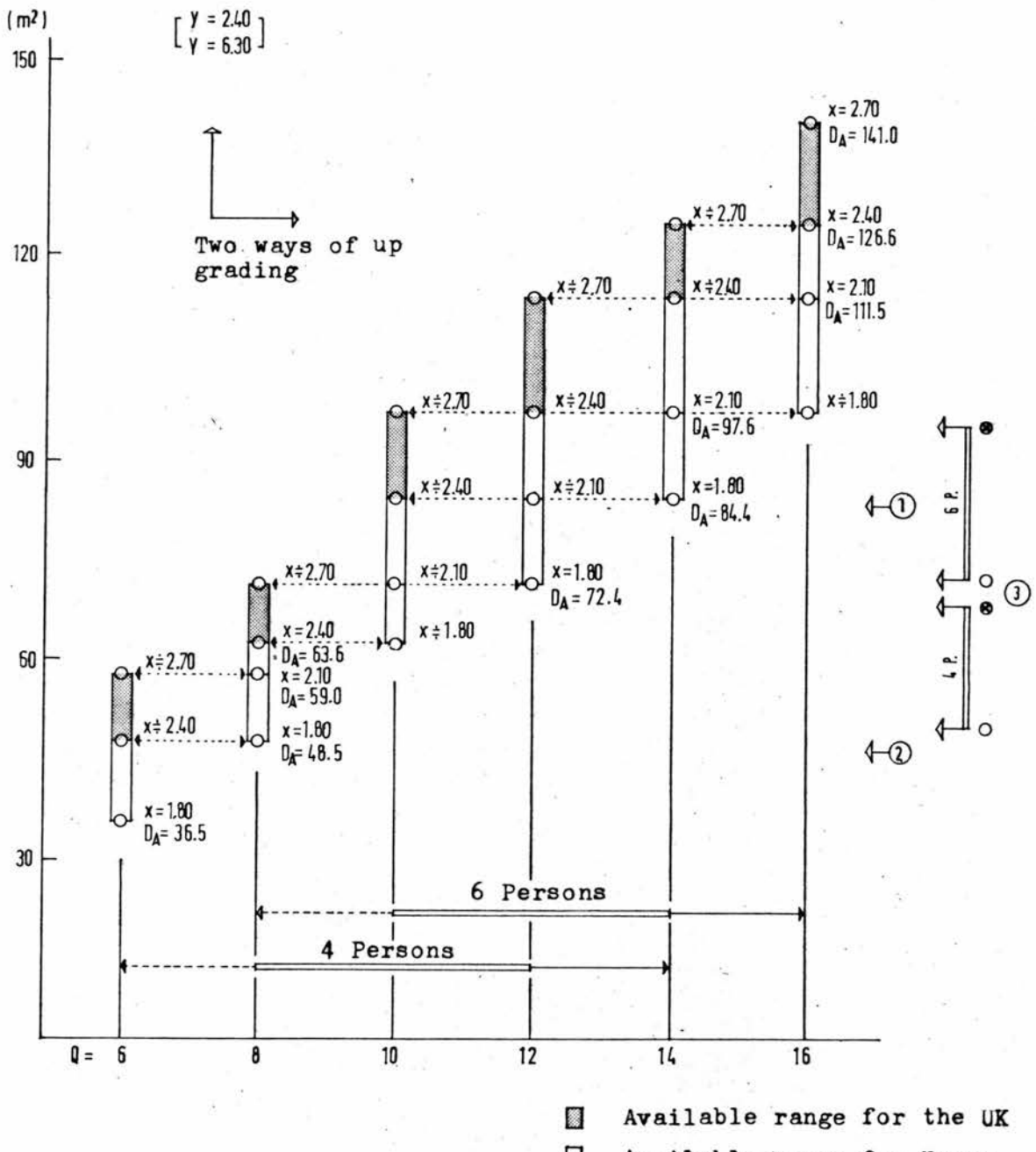


Fig. 6.2 Adaptable House Plan - Catering for Changing Q for the UK and Korea



▨ Available range for the UK

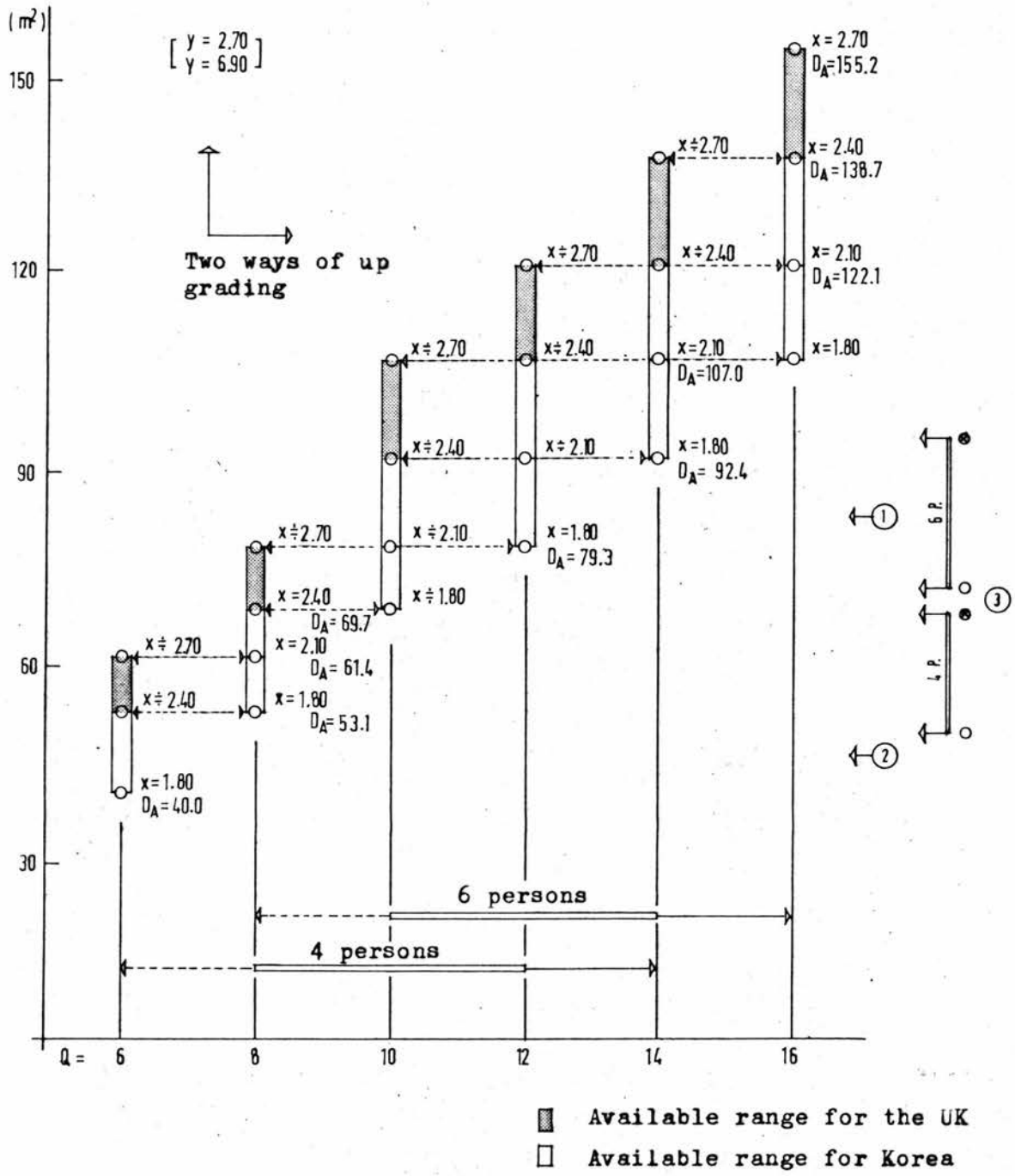
□ Available range for Korea

① The UK's Space Standard for 6 Person

② Average dwelling size of whole country(43m²) for 5.3 persons in Korea

③ Chombart de Lauwe (●-16m² per person, o-12m² per person)

Fig. 6.3-1 Adaptable House Plan Showing the Relationship between Dwelling Area, xy Dimension and Q. Comparison with Some Suggesed Space Standards (y - 2.40)



① The UK's Space Standard for 6 persons

② Average dwelling size of whole country(43m²) for 5.3 persons in Korea(1970)

③ Chombart de Lauwe (●-16m² per person, ○-12m² per person)

Fig. 6.3-2 Adaptable House Plan showing the Relationship between Dwelling Size, xy Dimension and Q. Comparison with Some Suggested Space Standards (y = 2.70).

On the left hand side of Fig. 6.4, the possible minimum and maximum dwelling area depending on Q (6 - 16), household size (4 or 6) and x (1.8 - 2.7m), y (2.4 or 2.7m) are shown graphically. The unshaded part of the diagram is for Korea, the lightly shaded is common and the dark area is the U.K. The right hand side of Fig. 6.4 is the minimum and maximum dwelling area per person depending on the variation of the same factors.

Table 6.1 indicates these figures in more detail: on the left hand side of the table, the possible range of the minimum and maximum dwelling sizes; on the right hand side of the table, the possible range of the minimum and maximum dwelling sizes per person. The shaded area shows the generally accepted range of functional segregation depending on the household sizes and the country to which it is to be applied.

If the very smallest size of house, i.e. for 4 persons without any dining room or common room (Q = 6), and the depth of the room being 2.4m is considered for Korea (minimum x = 1.8m), the dwelling area is 36.5m^2, and the dwelling area per person is 9.1m^2, but if the room depth increases to 2.7m, the dwelling area is 40m^2 and the dwelling area per person is 10m^2. For 6 persons a room depth of 2.4m, Q = 8, will give 48.5m^2 and 8.0m^2; if the room depth is 2.7m, the dwelling area and the dwelling area per person will be 53.1m^2 and 8.8m^2.

It is clear from Table 6.1 that as the household size increases, the dwelling area per person decreases. However,

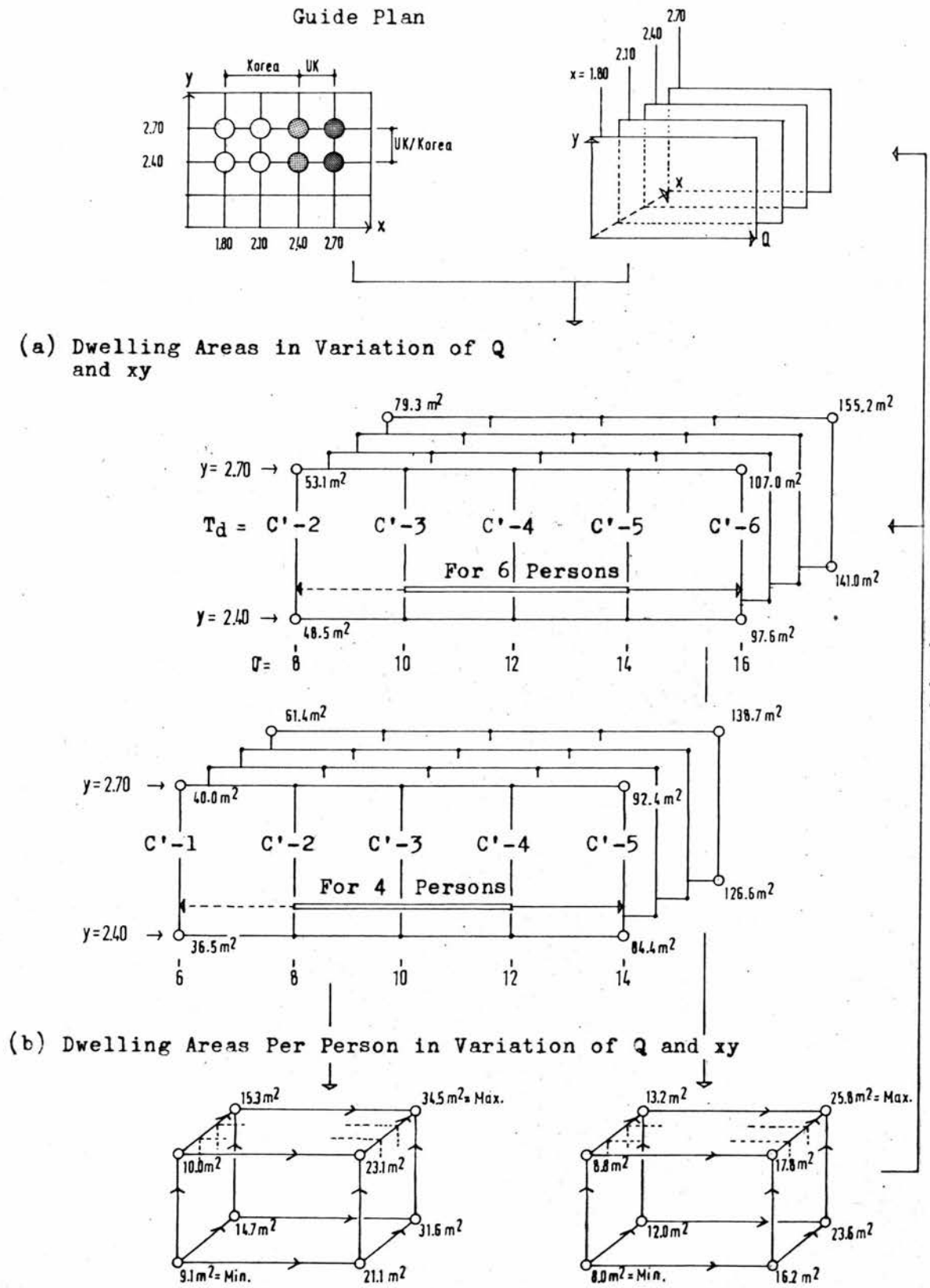


Fig. 6.4 Comparison between the Limited Maximum and Minimum Areas Per Person in Variation of Q and xy

Table 6.1 Possible Ranges of Dwelling Area Per Person in the Adaptable House Plan Given by the Variation of Q, x and y

		Dwelling Area (m^2)					Dwelling Area Per Person (m^2)				
	y-2.70 • / y-2.40 ○	8	10	12	14	16	Q = 8	10	12	14	16
6 persons	x=2.70 •	79.3	107.0	122.1	138.7	155.2	13.2	17.8	20.3	23.1	25.8
	x=2.70 ○	72.4	97.6	11 .5	126.6	141.0	12.0	16.2	18.6	21.1	23.5
	x=2.40 •	69.7	92.4	107.0	122.1	138.7	11.6	15.4	17.8	20.3	23.1
	x=2.40 ○	63.6	84.4	97.6	111.5	126.6	10.6	14.0	16.2	18.6	21.1
	x=2.10 •	61.4	79.3	92.4	107.0	122.1	10.2	13.2	15.4	17.8	20.3
	x=2.10 ○	59.0	72.4	84.4	97.6	111.5	9.8	12.0	14.0	16.2	18.6
	x=1.80 •	53.1	69.7	79.3	92.4	107.0	8.8	11.6	13.2	15.4	17.8
	x=1.80 ○	48.5	63.6	72.4	84.4	97.6	8.1	10.6	12.0	14.0	16.2
4 persons	x=2.70 •	61.4	79.3	107.0	122.1	138.7	15.3	19.8	26.7	30.5	34.5
	x=2.70 ○	59.0	72.4	97.6	111.5	126.6	14.7	18.1	24.4	27.9	31.6
	x=2.40 •	53.1	69.7	92.4	107.0	122.1	13.2	17.4	23.1	26.7	30.5
	x=2.40 ○	48.5	63.6	84.4	97.6	115.5	12.1	15.9	21.1	24.4	27.9
	x=2.10 •	-	61.4	79.3	92.4	107.0	-	15.3	19.8	23.1	26.7
	x=2.10 ○	-	59.0	72.4	84.4	97.6	-	14.7	18.1	21.1	24.4
	x=1.80 •	40.0	53.1	69.7	79.3	92.4	10.0	13.2	17.4	19.8	23.1
	x=1.80 ○	36.5	48.5	63.6	72.4	84.4	9.1	12.1	15.9	18.1	21.1
	Q =	6	8	10	12	14	6	8	10	12	14

UK — Korea — Max. / Up grading / Min.

Shaded part is the most useful area

if the room depth increases, this produces a larger dwelling area per person.

This conclusion can be compared with that of Chombart de Lauwe[1] who found that: if less than $12m^2$ is allowed per inhabitant, which is the absolute lower limit, abnormal social behaviour could be expected; if less than $16m^2$ is allowed per inhabitant, there would exist a danger of social decline.

Also it can be compared with the U.K.'s dwelling space standard and the average existing dwelling size in Korea as well as that shown in Figs. 6.3-1 and 6.3-2 . The U.K.'s dwelling space standard for a single storey house for 6 persons $(83.5m^2)^2$ is almost the same as the lowest dwelling area for 6 persons (Q = 10, y = 2.4m) in the diagrams. The 1970 average dwelling area for 5.3 persons[4] for Korea $(43m^2)^3$ is lower than the lowest dwelling area for 6 persons (Q = 8, y = 2.4m) given in the Figures.

1, 2, 3. See Chapter II, 2. (Figs. 2.1 and 2.3).

4. Census 1970 by EPB of Korean Government: average household size. (See also Fig. 2.3 above).

3. REASONS BEHIND GENERAL PREFERENCES FOR ARRANGEMENT OF ROOMS.

In order to validate many of the assumptions contained in the analysis of the house plan, it would be useful to conduct enquiries among the general public to discover the kind of houses that people like. A great variety of questions must be prepared and put to a large number of people from all walks of life and in all parts of the country. These questions must cover every conceivable preference relating to dwellings and their surroundings. Unfortunately, so far, these questions have only been put to certain people in certain situations. The answers should show what is essential in a house, and what is not, what is convenient and what is not, etc.

There is one aspect of the matter which prompts a critical examination of the stated preferences of the majority. People, especially in their daily habits, are very conservative. It is a tendency borne of the liking for security. There is an instinctive dislike of the unknown. People will therefore generally have a bias for the familiar rather than for the unfamiliar. This is less likely with the young and adventurous, who are often willing to try new things, than the older people.

The following breakdown of general preferences, in the U.K. and Korea, shows the reasons for present accepted arrangements. Fig. 6.7 shows an example of the result of the investigation into room arrangement, degree of functional segregation and dwelling size which offer people a free choice of house plan.

3.1 Topological Relationships.

There are two topological relationships involved: internal relationships of rooms and the relationship of the inside of the house to the outside. When considering topological arrangement of rooms certain points must be borne in mind. Should there be a connection between two rooms (young children may need supervision) or should particular rooms always be kept separate to minimize noise, cut down cooking smells and create privacy? People usually prefer to have their living rooms facing south and accept bathrooms facing north. It is also preferable to have a south facing bed/sitting room, dining room and kitchen (depending on the country) but the dimension of the house frontage limits the possible number of south facing rooms. However, the plan must be flexible enough to permit the occupant to make his own decision regarding arrangement.

To take a simple example: the house plan is to comprise several rooms - a living room (L), a dining room (D), a kitchen, (K), Bed/sitting room (B), ... There will also be some circulation space (C), a hall or corridor giving access to the rooms.

The overall shape of the plan is to be rectangular, though of no fixed dimensions: and we shall label the areas outside the house on four sides N, S, E and W for the points of the compass, so as to identify them.

The topological relationships can be broken down into several components as illustrated in Fig. 6.5(a) which shows a series of basic forms which represent rooms in a house

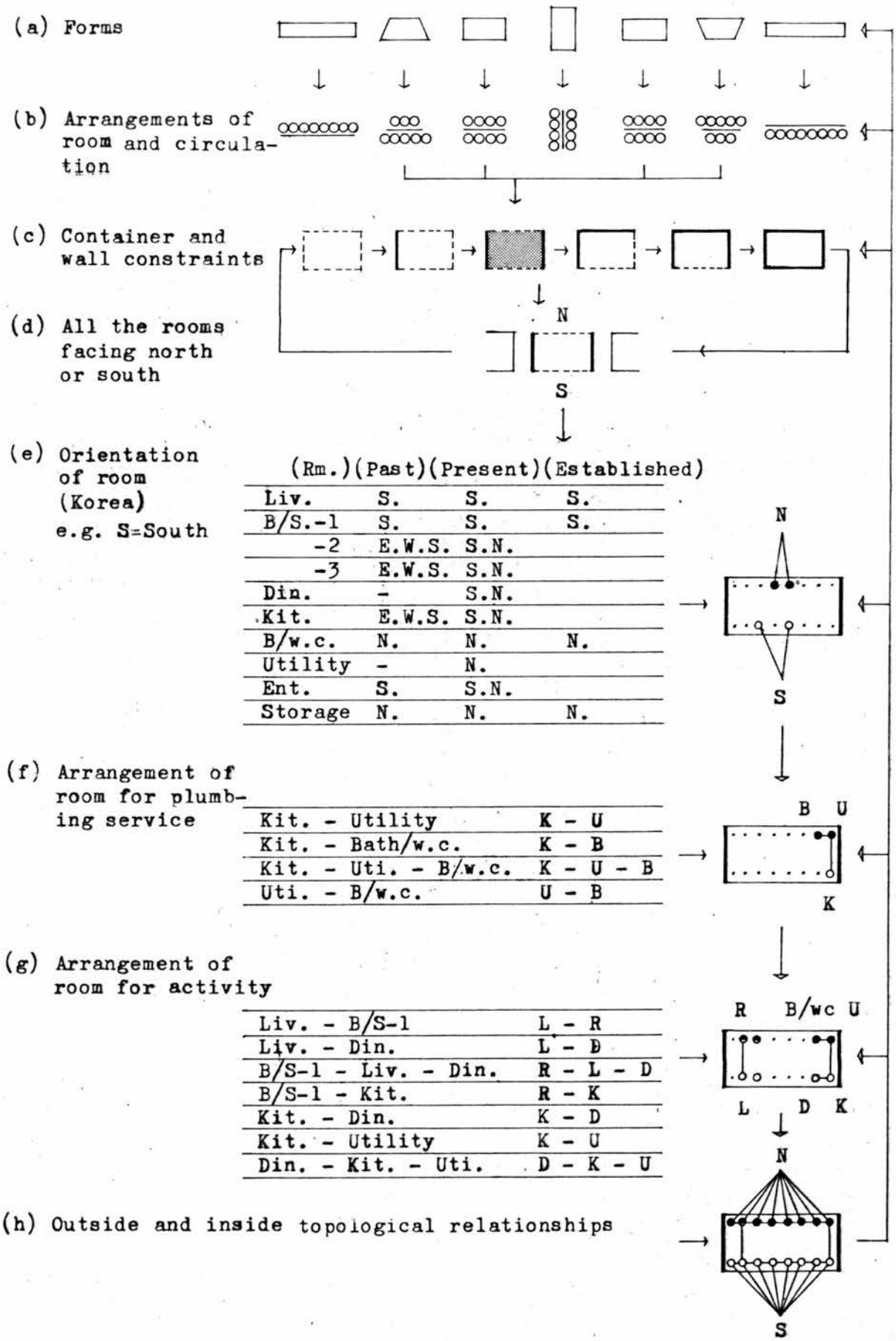


Fig. 6.5 Overall Frame Work of the Topological Relationship

plan (the actual shape should be rectangular); (b) represents possible room arrangements in single and dual aspect plans: for the purposes of this investigation, however, only dual aspect plans are studied. In (c) the constraints on the outer wall of the house plan are shown. Only the plan which is east/west with blind walls on these sides, is considered. (d) represents the topological relationship of inside/outside and shows all the rooms facing north or south, (e) is a comparison of past and present room orientation preferences in Korea. From this it is concluded that the general preference is for the living room and at least one bed/sitting room to face south and for the storage area and W.C./bathroom to face north. To facilitate economic plumbing, the kitchen should be near either the bathroom/W.C. or the utility space or both, as explained in (f). Similarly (g) shows several alternative topological relationships of particular rooms. Finally (h) shows inside and outside topological relationships in relation to (e), (f) and (g) with a given number of rooms and given wall constraints.

3.2 General Preferences for Plan Arrangements with Regard to the Topological Relationship of Rooms - a General Guideline.

Inside

Living Room

i) The main living room area has a view of the front garden and easy access to it. U.K./Korea

ii) The main living area has privacy from callers approaching the main entrance. U.K./Korea*

iii) Members of the household can get from the main entrance to their bed/sitting room without disturbing the main living room. U.K./Korea*

iv) Members of the household can get from bed/sitting room to the bathroom/W.C. room without going through the main living area. U.K./Korea*

v) The living area will be less disturbed when it is situated at the end of the house plan. U.K./Korea

Master Bed/sitting Room

i) This room has some view of the front garden and callers. Korea

ii) It has privacy from callers approaching the main entrance. U.K.

iii) It is linked to the main living room. Korea

iv) The parents need to sleep near their young children, so that they can attend to them easily. U.K./Korea

Children's Bed/sitting Room

i) The children can get from the main entrance to their bed/sitting rooms without going through the main living area. U.K.

ii) When reaching adolescence, they do not need to be near the parents. U.K./Korea

iii) These bed/sitting rooms face south. Korea*

Kitchen

i) The kitchen has some view of and close access to the garden, for supervising children's play, hanging washing, etc. U.K./Korea

ii) It has direct access or proximity to the dining area. U.K./Korea

iii) To prevent cooking smells reaching the main living area - it is preferable to situate the kitchen and living area well apart. U.K./Korea

iv) The kitchen has convenient access to the outside refuse store and jar storage (Korea) without going through the main living area. U.K./Korea

v) The kitchen can overlook the dining room and the main living area in order that mother can serve both areas. U.K./Korea*

Dining Room

If a spare room has been provided for conversion to an extra living/dining area, this should be situated near the dining room which should also be close to the main living room. U.K./Korea

Bathroom/W.C.

i) W.C. and wash hand basin are near the entrance and can be easily reached from the dining and other work area. U.K./Korea*

ii) There are adequate arrangements to prevent smells reaching the main living area or dining room. U.K./Korea

iii) Heating boiler facility should be attached to both rooms so as to minimise heating loss. U.K./Korea

Utility

The utility room has basically washing and ironing facilities. U.K./Korea*

Outside.

Garden

If garden is only allowed on one side of the building it should be facing south. Korea

Gate Way

This should also face south as people prefer to approach a house from this direction. If this is not possible, approach should be from east or west avoiding north as far as possible as this is the least desired direction psychologically, from which to approach. Korea

Jar Storage [1]

The jar storage should be in the sun (these jars contain fresh vegetables and bean sauce, etc. which require sun light). Korea

Playing Area

If possible this should be in or near sunny garden. U.K./Korea

Drying Area

This should also be sunny. U.K./Korea

* (Usually but not always)

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1. See Appendix H (pp. 186-187)

4. SOME EXAMPLES OF THE GENERATION OF ADAPTABLE HOUSE PLANS.

Following the guideline laid down previously, some examples of the adaptable house plan are developed. These adhere to the generally accepted guideline as required to meet any change in a household size plus functional segregation giving the number of spatial units required (Q) within a given range of x and y dimensions. These are analysed at part 2. These plans apply to both the U.K. and Korea by adopting the appropriate x and y respectively. Fig. 6.6 shows the topological relationships from which the plans shown in Fig. 6.7 are developed. As Q increases, a greater variety of plans are produced. In Fig. 6.6 the broken lines indicate plumbing connections mentioned previously. In Fig. 6.7 the lines emanating from certain rooms (e.g. the kitchen or master bed/sitting room) represent uninterrupted lines of vision.

As a general guideline it is more spatially economic to situate common rooms (i.e. living room or dining room) at the end of the corridor, so the circulation space of the corridor can be incorporated into the living or dining room area.

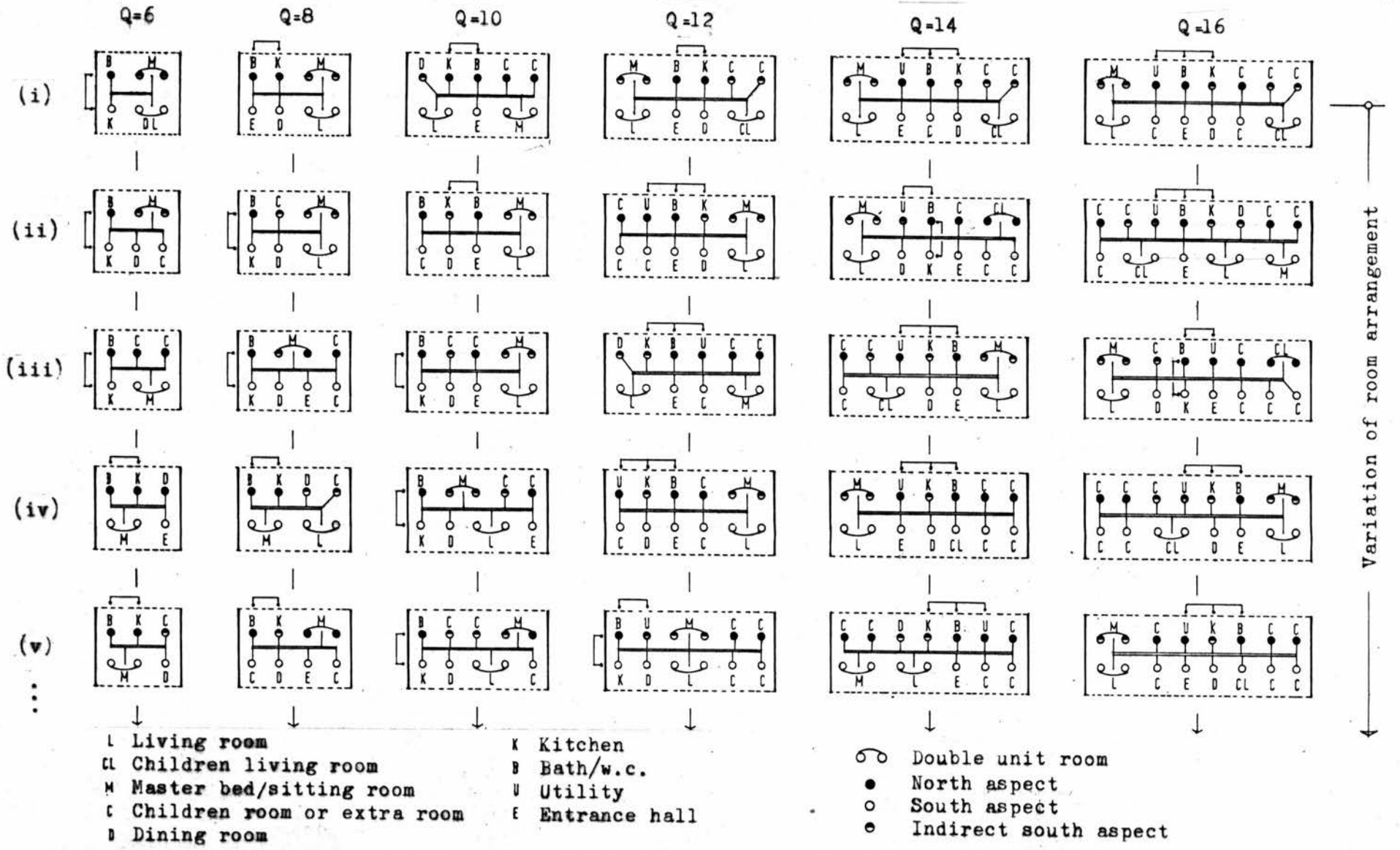

Fig. 6.6 Possible Range of Room Arrangements in the Required Topological Relationship

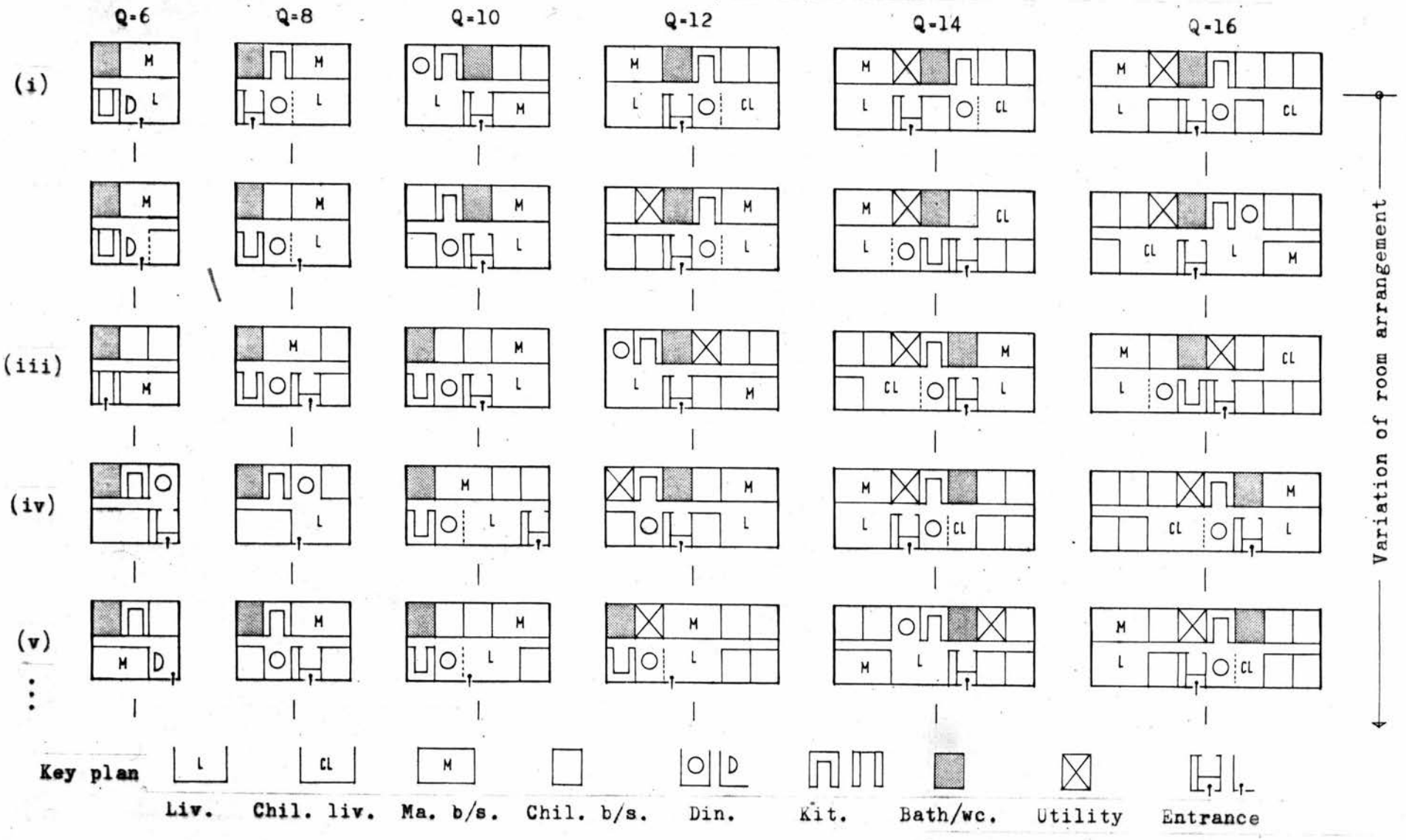

Fig. 6.7 Example of the Generation of Adaptable House Plans

x=1.80-2.40 for Korea
x=2.40-2.70 for the UK
y=2.40, 2.70 for the both countries

5. GENERATION OF MINIMUM PLOT LAYOUT.

This section investigates the possible range of economic compact plot areas and dimensions (or configurations) with regard to the house plan previously studied. The overall framework and evaluation factors are shown in lower part of Figs. 3.5 and 3.6. The evaluation factors are: overall building site layout; privacy; sunlight and daylight; orientation; activity space required outside; and economic passage access. Precise figures regarding minimum standards for sunlight and daylight are given by a Code of Practice.[1]

Two possible plot dimensions (P_X, P_Y) are considered. Plot width (P_X) depends on building layout and dwelling type (detached, semi-detached and terraced). Dwelling type affects plot width because of the amount of space which must be left between the perimeter house wall and the plot boundary. In the case of the terraced house this problem does not arise. More area is needed if the house is detached than if it is semi-detached.

5.1 Plot Width.

In Korea, there are fewer building regulations controlling the distance between the house wall and the boundary than in the U.K. It is not affected by windows as it is in the U.K. but it does vary according to the housing district. In residential areas, the minimum distance between neighbouring perimeter walls must be 3m but in mixed areas the regulations only demand 1m between houses, i.e. 0.5m on either side of the boundary fence.

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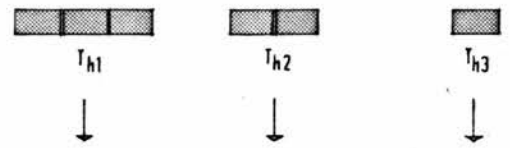
1. British Standard Code of Practice Ref. Chapter 1-B (1945) and Chapter 1-A (1949).

(a) Type of Building (T_h)

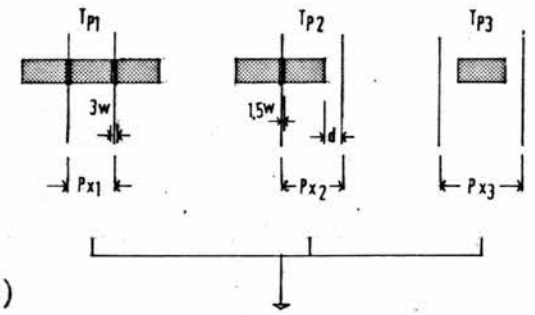
(Terraced, attached and detached house)



(b) Relationship Between Plot Width and Type of Building Layout (T_p)

$P_{X1} = X_A + 3w$
$P_{X2} = X_A + (3w + d)$
$P_{X3} = X_A + (4w + 2d)$

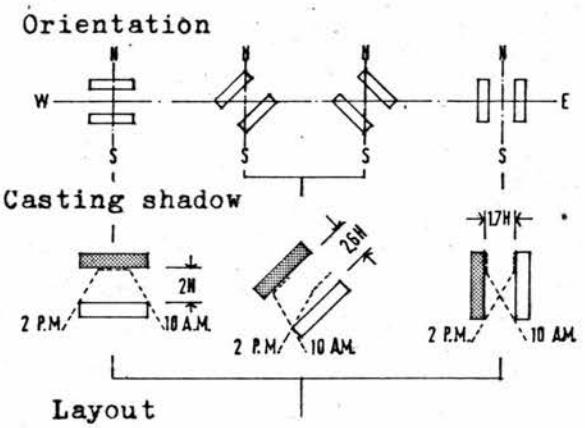
w=0.1m(Wall thickness unit)
d=1m(UK), 1-1.5m(Korea)



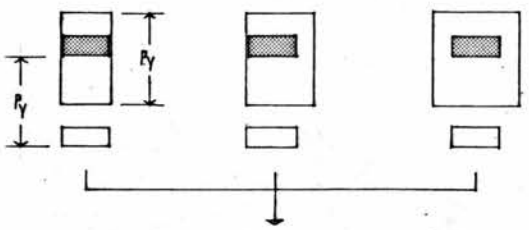
(c) Relationship Between Plot Depth and Buildings Layout

i. Sunlight facter(Korea)

Latitude 40° N, 4hrs. sunlight for winter solstice at parallel buildings (Korea = 33-43° N)



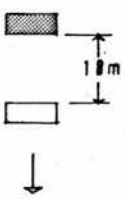
$P_Y \geq (Y + 4w) + (2H \text{ or } 2.6H)$



ii. Privacy factor(UK)

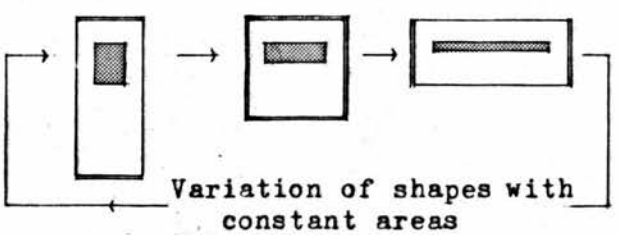
Constant distance of 18m is required

$P_Y \geq (Y + 4w) + 18m$



(d) Economic Arrangement of Access

Shorter side of rectangular plot shapes(double line)



Feed back

Fig. 6.8 Relationship Between Building Type, Layout and Plot Plan

Building regulations for the U.K. are slightly different but depend on the type of building. If there are windows in the side, minimum distances depend on thermal radiation density[1]. However, as all house plans in this study have blind walls on either side (gable ends), the only regulation is that there must be at least 1m. from the side of the house to the plot boundary[2].

Therefore, in Korea,

$$P_X = (X + 2w) + (0, 1 \text{ or } 2)d$$

d(Clearance) must be either 0, 0.5 or 1.5m.

2 w=External wall thickness

In the U.K. d can equal 0 but must not be between 0 and 1m.

5.2 Plot Depth.

Plot depth comprises front and back yard or garden depths and also the depth of the house. In the U.K., the front garden is generally smaller than the back, unlike Korea where the front garden is usually much larger than the back. There are several criteria for plot depth: sunlight/daylight; privacy; and space required for outdoor activities.

Sunlight/Daylight Factor

In Korea, the Sunlight factor is only important for residential buildings of over five storeys. Regulations state that, to permit adequate light, the distance between such buildings should equal their height.

As a general rule, the distance required between buildings differs according to the orientation of the build-

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1. Building Standards (Scotland) (Consolidation) Regulations 1971, D. 17, p. 29.
2. Ibid., (D.17, 5.).

ings. If parallel buildings run directly east/west, at a latitude of 40°N (this applies to most houses in Korea), and two hours sunlight is required in the winter solstice, the distance needed is 2H (twice the height). However, if the buildings are situated northeast/southwest or northwest/southeast, the increased distance of 2.6H will be required. For north/south buildings, less distance is needed and 1.7H is sufficient but this orientation is less popular among occupants although less land is consequently needed. Thus 2H is the most suitable minimum distance for houses facing directly north/south, i.e. running east/west and this was used as an unofficial standard for calculations in this study.

More complicated regulations apply in the U.K., where siting of houses is controlled by angles of obstruction. For example, if two neighbouring buildings stand on level ground, there must be an angle of 43° formed by the boundary at ground level and the top of the house walls (assuming that the roofs are not excessively steep as this would necessitate greater distances to allow adequate light). The angle between ground level and the line from the wall of one house at ground level to the top of the neighbouring roof should be 25°.

Privacy Factor

A further regulation covers distances between windows in neighbouring buildings. These depend on the angles of incidence at the planes of the windows. So for parallel buildings, the minimum distance between them must be 18m. as

the line of vision creates 90° angle with the window, and this is the stipulated minimum distance.

Space Required for Outdoor Activity

This is a matter of personal preference and so no definite statement can be made covering minimum areas required for playing, gardening and similar pursuits. In this thesis, it has been assumed that this factor will have been considered under privacy.

Therefore in Korea

$$P_Y \geqslant (Y + 4w) + (2 \text{ or } 2.6)H$$

In the U.K. for single storey buildings

$$P_Y \geqslant (Y + 4w) + 18m$$

and for higher houses must also satisfy

$$P_Y - (Y + 4w) \geqslant \text{Cotan } 25^{\circ} \; H$$

$$P_{Yf} \text{ or } P_{Yb} \geqslant \text{Cotan } 43^{\circ} \; H$$

Fig. 6.8 shows different types of buildings (detached, semi-detached and terraced); building layout and plot width (clearance on either side, clearance on one side, no clearance on either side).

Fig. 6.9 shows the relationship between building type; layout and plot plan for Korea and the U.K. It also shows minimum and maximum plot areas with regard to Q, xy, type of building layout and orientation in given latitude and hours of sunlight actually received.

For example, in Korea a north/south parallel layout (2H spacing required) in which Q = 8 (4 persons), y = 2.4, x = 1.8m, d = 1m, H = 4m produces $P_X = 10.1m$, $P_Y = 14.3m$.

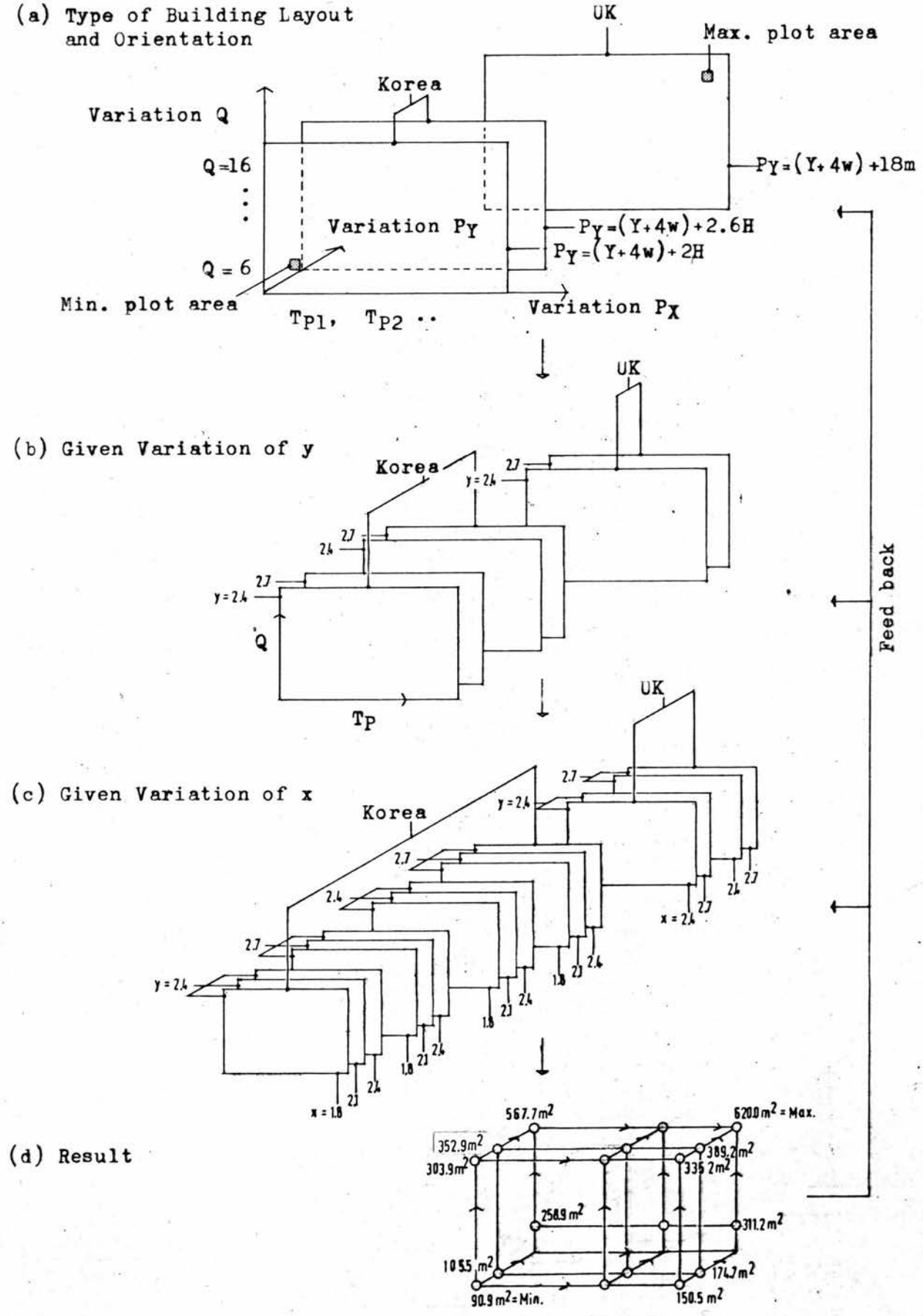


Fig. 6.9 Comparison Between the Limited Maximum and Minimum Plot Areas in Variation of Building Type, Layout, Q, x and y

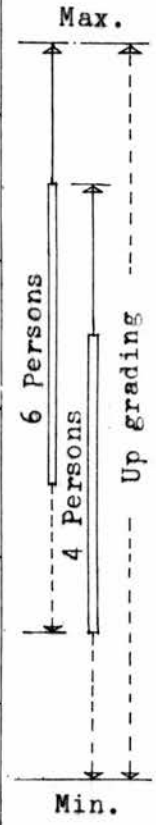
Table 6.2 Possible Range of Compact Plot Areas and Shapes for the Adaptable House Plan Given by the Variation of Type of Layout, Q and x

UK

Plot Depth: Privacy factor (UK) P_Y=18m-Y=24.9m ; Sunlight factors (Korea) P_Y=(2.6H+Y) or (2H+Y)= 17.3m or 14.9m (H=4m, y=2.7m, w=0.1m)

Plot Width;		$P_X=X_A+3w$				$P_X=X_A+(3w+1m)$				$P_X=X_A+(4w+2m)$			
		x-1.8	2.1	2.4	2.7	1.8	2.1	2.4	2.7	1.8	2.1	2.4	2.7
Q-16	P_X	(15.8)	(18.0)	(20.4)	(22.8)	(16.9)	(19.1)	(21.5)	(23.9)	(17.9)	(20.1)	(22.5)	(24.9)
	P_Y-24.9	-	-	507.9	567.7	-	-	534.1	595.1	-	-	560.2	620.0
	17.3	273.3	311.4	352.9	-	292.3	330.4	371.9	-	309.6	347.7	389.2	-
	14.9	235.4	268.2	303.9	-	251.8	284.6	320.3	-	266.7	299.4	335.2	-
Q-14	P_X	(13.7)	(15.8)	(18.0)	(22.8)	(14.8)	(16.9)	(19.1)	(21.5)	(15.8)	(17.9)	(20.1)	(22.5)
	P_Y-24.9	-	-	448.2	507.9	-	-	475.6	534.1	-	-	500.5	560.2
	17.3	237.0	273.3	311.4	-	256.0	292.3	330.4	-	273.3	309.6	347.7	-
	14.9	204.1	235.4	268.2	-	220.5	251.8	284.6	-	235.4	266.7	299.4	-
Q-12	P_X	(11.8)	(13.7)	(15.8)	(18.0)	(12.9)	(14.8)	(16.9)	(19.1)	(13.9)	(15.8)	(17.9)	(20.1)
	P_Y-24.9	-	-	393.4	448.2	-	-	420.8	475.6	-	-	445.7	500.5
	17.3	204.1	237.0	273.3	-	223.1	256.0	292.3	-	240.4	273.3	309.6	-
	14.9	175.8	204.1	235.4	-	192.4	220.5	251.8	-	207.1	235.4	266.7	-
Q-10	P_X	(10.4)	(11.8)	(13.7)	(15.8)	(11.5)	(12.9)	(14.8)	(16.9)	(12.5)	(13.9)	(15.8)	(17.9)
	P_Y-24.9	-	-	341.1	393.4	-	-	368.5	420.8	-	-	393.4	445.7
	17.3	179.9	204.1	237.0	-	198.9	223.1	256.0	-	216.2	240.4	273.3	-
	14.9	154.9	175.8	204.1	-	171.3	192.4	220.5	-	186.2	207.1	235.4	-
Q-8	P_X	(8.0)	(9.2)	(10.4)	(11.8)	(9.1)	(10.3)	(11.5)	(12.9)	(10.1)	(11.3)	(12.5)	(13.9)
	P_Y-24.9	-	-	258.9	293.8	-	-	286.3	321.2	-	-	311.2	346.1
	17.3	138.4	159.1	179.9	-	157.4	178.2	198.9	-	174.7	195.5	216.2	-
	14.9	119.2	138.0	154.9	-	135.6	153.4	171.3	-	150.5	168.3	186.2	-
Q-6	P_X	(6.1)	(-)	(8.0)	(9.2)	(7.2)	(-)	(9.1)	(10.3)	(8.2)	(-)	(10.1)	(11.3)
	P_Y-24.9	-	-	-	-	-	-	-	-	-	-	-	-
	17.3	105.5	-	138.4	-	124.5	-	157.4	-	145.4	-	174.7	-
	14.9	90.9	-	119.2	-	107.8	-	135.6	-	122.2	-	150.5	-

Min. ---------- Up grading ---------- Max.



These dimensions produce an overall plot area of m^2. This can be compared with the existing site average in the Korean capital city, Seoul, of $119m^2$ per detached house.[1] When Q = 16 (6 persons), x = 1.8m, y = 2.4m, P_X 17.9m, P_Y 14.3m, , giving a plot area of $255.9m^2$.

In the U.K., where privacy is the main factor, with a parallel building layout, (18m spacing required), when Q = 8 (4 persons), x = 2.4m, y = 2.4m, Px = 12.5m, Py = 24.3m; so a plot of $310m^2$ is produced. If Q = 16 (6 persons), x = 2.4m, y = 2.7m, Px = 22.5m, Py = 24.9m and the plot area is $560\ m^2$.

This concept is illustrated in Fig 6.9 and Table 6.2 in which details of Q; xy; overall site building layout and orientation for Korea and the U.K. are given. In addition, these Figures illustrate the range of plans available from the minimum to the maximum (they also show semi-detached and terraced houses which have a smaller plot area).

One further consideration is access. To economise on road costs it is normally preferable to situate the access on the shorter side of the plot. In the U.K. this is quite straightforward, but in Korea, approach from the north is not desirable and so access must be from some other direction.

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1. Economic Planning Bureau (E.P.B.) in Korea, August 1978.

6. SUMMARY AND CONCLUSIONS.

In this Chapter we have seen why people prefer certain topological arrangements in their houses, arrangements which must be considered when formulating a house plan. Coupled with this need to adhere to certain arrangements is the need to create a house plan which allows people freedom to arrange their rooms as they wish, depending on the requirements of each individual household as its size increases or decreases. Sufficient area must be allowed for functional segregation within each house, and also there are economic factors such as compactness of plumbing.

A guideline was drawn up to give a general indication of what is required in the formulation of the house plan. Various household sizes were studied and compared to discover what sort of areas were required and different room depths were considered.

Not only was the possibility of interchanging rooms explored, but also the possibility of altering the number of rooms and the area required to do this. In fact very little extra space is needed for this adaptable house plan.

The overall configuration is controlled by Q and x, y, so there is little choice in the ratio of overall depth to width ($^{X}/_{Y}$).

Minimum and maximum dwelling area required depends on: the degree of functional segregation, household size and given room depth. If the very smallest size of house, i.e. without any dining room or common room, is considered for Korea (x = 1.8m) for 4 persons (Q = 6), the dwelling area

per person is $36.5m^2/4 = 9.1m^2$ (y = 2.4m.) and $40m^2/4 = 10m^2$ (y = 2.7m.), but for six persons, $48.5m^2/6 = 8.1m^2$ (y = 2.4m.), and $53.1m^2/6 = 8.8m^2$ (y = 2.7m). In the largest house, (i.e. with a children's living room) for 4 persons (Q = 14) for the U.K. the dwelling area per person is $126.6m^2/4 = 31.6m^2$ (y = 2.4m), and $138.7m^2/4 = 34.6m^2$ (y = 2.7m); for 6 persons (Q = 16), $141m^2/6 = 23.5m^2$ (y = 2.4m) and $155.2m^2/6 = 25.8m^2$ (y = 2.7m).

It is clear from Fig. 6.4 that when the household size increases, the dwelling area per person decreases. Conversely, if the room depth (y) increases, this produces a larger dwelling area per person.

There are some examples of adaptable house plans given in Fig. 6.7 which are based upon the information given previously. They all cater for different possible arrangements and areas depending on Q, x, and y.

Also studied in this Chapter was plot size as affected by the house frontage, clearance distance and the dwelling type. These control plot width, but plot depth is determined by different factors; the dominant factor in the U.K. is probably privacy, whereas in Korea sunlight is more important.

CHAPTER VII

GENERAL CONCLUSION

1. SUMMARY AND FINAL CONCLUSIONS.
2. SUGGESTION FOR FUTURE RESEARCH.

1. SUMMARY AND FINAL CONCLUSIONS.

This thesis was prompted by an urgent need to develop a practical house plan using a method which could be suitable for use all over the world and which would make the fullest use of dwindling natural resources without being too expensive to produce. To cater for such a wide market, it had to be adaptable to fit in with differing cultures, climates, living standards and also personal preferences and yet remain economic.

Already, a step had been taken in the right direction with the development of the 'Metric Shell' (NBA 1968) which allowed for some variation in arrangements, but which did not take account of individual preferences and did not permit as much flexibility as may be considered both desirable and necessary by many architects and planners throughout the world.

Many obstacles hindered the development of such a plan. It had to be able to adapt to changing living standards, and thus to changing housing standards in a variety of countries. Climatic differences are important as these affect peoples' life-styles, and traditions had to be considered also, so the problem facing the designer is to develop a flexible house plan framework, within which the occupant can rearrange rooms to suit his own needs.

A number of possible plans were studied to assess their suitability for this purpose and to discover what arrangements permitted the maximum interchangeability of rooms. Also investigated was the amount of extra space which would

be necessary if the plan was to be adaptable. Minimum and maximum room sizes and dwelling areas for the U.K. and Korea were compared. These depend on the degree of functional segregation, and the household size. House plans, based upon the data studied which give the occupant the maximum choice of arrangements were illustrated in Chapter VI. These plans can be extended if more rooms are required. This approach would also seem to have many advantages when considering the needs of mass production techniques.

The development of the house plan was taken a stage further and plot plans were investigated. Plot plans are affected by the frontage of the house and also by cultural differences which result in slightly different plot depths for the U.K. and Korea. This study has made it more easy to determine plot sizes and therefore the ultimate amount of land which will be required for building.

From this study the following facts and figures have emerged: Before deciding on any new floor space rates, planners should study existing rates for different social and economic groups, bearing in mind that if insufficient floor space per person is allowed, social decline may result.

Perception space - both thermal and tactile - is a vital consideration for dwelling area. Overlapping of space aids compactness if used considerately but if abused, this will only create cramped conditions.

Room area, which is determined by furniture and fittings, is directly related to overall dwelling area and

richer countries use more space than poor ones.

A square plan is more economic than a rectangular one but in Korea a wide frontage plan is preferable as it allows more sunlight and ventilation. The optimum shape of house plan for Korea is 1:1.6 within the range of 1:1 to 1:2.4. In Korea the tendency is for multi-purpose rooms but an investigation is taking place and customs are changing. Already, the National Building Agency had developed two and three storey houses consisting of "room components" which could be altered slightly if necessary. This overall plan was termed the 'Metric House Shell' and the concept is further developed here into a form allowing maximum adaptability of plans. (Chapter II)

A rectangular (modular) spatial unit is recommended, following study of space standards for several countries. The number of units is related to family size and the degree of functional segregation. Differing customs mean different types of house in different countries.

The suggested framework can be continually checked by feedback of component criteria to produce a range of suitable house plans. (Chapter III)

All the possible frame plans which were produced were then analysed to find which arrangements permitted the most interchangeability of rooms. The Type C' plans shown in Table 4.1 were selected for further study. In these plans, the number of north-facing spatial units equals the number of south-facing units and these plans were analysed in conjunction with the overall configuration ratio, household

size plus functional segregation, dwelling area and spatial unit dimensions. (Chapter IV)

After study of particular individual rooms to assess their component factors, it becomes apparent that room size and configuration are interdependent. It was concluded that the common dimension of compact room size in the U.K. and Korea is $\bar{x}$ = 2.4m, $\bar{y}$ = 2.4m (All doors in these plans are sliding, saving space). (Chapter V)

Figures given in Table 6.1 show the effect of a change in Q upon the house plan. If the household size increases dwelling area per person decreases, but if room depth is increased, greater dwelling area per person results. An investigation of preferred plan arrangements revealed the reasons behind them and also the need for certain topological relationships. It is recommended to situate common rooms, such as the living room, at the end of the corridor to save circulation space and also to keep rooms which require plumbing as close together as possible. Should the need arise, rooms can still be changed around or altered in number to suit the occupant.

Two possible plot dimensions were suggested for the U.K. and Korea. Building controls in Korea demand a minimum of 3m between houses in residential districts and 1m in mixed areas. Plot depth is determined by the height of neighbouring buildings and the amount of sunlight/daylight they permit to reach other buildings. The U.K. regulations are based on windows and fire risk (plot width). Plot depth is determined by angles of obstruction. (Chapter VI)

2. SUGGESTION FOR FUTURE RESEARCH.

An area which will still require further development is research into the users' reactions and opinions after these proposed plans have been tried out.

Building costs must also be compared. These costs will include such features as the removable walls and any possible extra cost involved in plumbing.

Finally further work is required to extend this method for application to two storey houses and multi-storey flats as these result in greater density of population and a consequent saving of land.

EXPLANATION OF SYMBOLS

R'' = Recommended room areas in certain countries.
R' = Recommended spatial unit area ($R' = \frac{\Sigma R''}{\Sigma u}$).
u = Number of spatial unit (Author's suggestion).

$\alpha\ \beta\ \gamma\ \varepsilon$ = Space components of room. Area involved: activity and elbow room(α); furniture and fittings(β); storage(γ); circulation(ε).
dx, dy = Dimensions (width and depth of space components of room.

x, y = Dimensions (width and depth) of room (spatial unit).
R = Adjusted spatial unit room area ($R = xy$)
x_N, x_S = Width of room unit facing north or south.
y_N, y_S = Depth of room unit facing north or south.
m = Number of rooms facing north.
m' = Number of rooms facing south.
n = Number of single unit or double unit rooms facing south.
n' = Number of single unit or double unit rooms facing north.
x/y = Room plan configuration ratio.

X, Y = Dimensions (width and depth) of house plan.
X/Y = House plan configuration ratio.
D = Dwelling area ($D = XY$)

P_X, P_Y = Dimensions (width and depth) of plot plan.
P_X/P_Y = Plot plan configuration ratio.
P = Plot plan area ($P = P_X \cdot P_Y$).

T_r, T = Arrangement of room.
T_d = Types of a modular spatial frame plan.
T_h = Types of building.
T_p = Types of building layout.

h = Household sizes.
f = Degree of functional segregation.
Q = Number of spatial room units required ($Q = h + f$).

N, N' = Series numbers refering to room dimensions.
T_N = Total linear graphic index for series number.
T_{NA} = Adjusted total linear graphic index.

X_A = Adjusted frontage of flexible house plan.
D_A = Adjusted area of flexible house plan.

H = Height of opposing building.
d = Minimum distance between side wall and boundary.
w = Thickness of internal wall.
$2w$ = Thickness of external wall.

MC. = Modular coordination.
G_r = Guideline for the arrangement of room.
G_h = Guideline for the room arrangement in house plan.
G_p = Guideline for the building layout.

S/D = Sunlight and daylight factors.
Pr = Privacy factor.
Sf = Space required for outdoor activities.
Ep = Direction of a shape of plot.

C = Width of corridor.
$\bar{x}, \bar{y}$ = The most suitable common dimensions of the compact room size as an interchangeable spatial unit

P_{Yf}, P_{Yb} = Depths of front yard and back yard in plot plan.

APPENDICES

APPENDIX A Housing Standard Data Sheets in Certain Countries.

Nation: BELGIUM
Source: National Report prepared for 28th IFHP World Congress
Object: Standard of the houses for low income, supplied by Société Nationale du Logement.

HOUSING STANDARD

sq. m.

No. of Persons	Detached Houses Min.	Max.	Apartments Min.	Max.
2	43	60	30	47
3	57	74	43	59
4	65	82	55	72
5	72	88	62	78
6	80	95	70	85
7	95	110		
8	105	120		
9	112	127		
10	117	132		

Nation: UNITED KINGDOM (1)
Source: Housing in Great Britain (1957)
Object: General housing

HOUSING STANDARD

No. of Persons	No. of Bedrooms	Superficial Area
4	2	69.5 – 74 m²
5	3	83.5 – 88.5
6	3	91 – 95.5
6	4	93 – 101
7	4	102 – 109

Remarks: (1) The standard of duplex house.
(2) Described in Housing Manual, 1944, 1949.
(3) Include the area of built-in cupboards where they are provided.

Nation: UNITED KINGDOM (2)
Source: Housing for To-day and Tomorrow (1961)
Object: The standards of design to future family dwellings and other forms of residental accommodation, whether provided by public authorities or private enterprise.

HOUSING STANDARD

Minimum Net Floor Area sq. m

No. of Persons	6	5	4	3	2	1
3-story house	97.6	94.0	—	—	—	—
2-story centre terrace	91.9	84.5	74.3	—	—	—
2-story semi or end Maisonette		81.7	71.5			
Flat	86.4	78.9	69.6	56.6	44.6	29.7
Single story house	83.5	75.2	66.0			

Remarks Definitions
Net floor area is the area on one or more floors enclosed by the walls of a dwelling and is measured to the opposing unfinished faces. It includes the area occupied by partitions the area taken up on each floor by any staircase the area of any chimney breast or flue, and the area of any external W C. It excludes the floor area of any general store, dustbin store, fuel store, garage or balcony; any area in rooms with sloping ceilings to the extent that the height of the ceiling does not exceed 5 ft. 0 ins; and any lobby open to the air

Nation: FRANCE (1)
Source: Politique de l'urbanisme et de la construction en France
Object: Public rental housing for lowest income.

HOUSING STANDARD

sq. m.

No. of Rooms	1	2	3	4	5	6	7
Area H L M Rental House	26–33	39–50	51–63	61–77	73–93	85–110	101–125

allowance up to + 10 % (61-May)

No. of persons	Rooms	Area (m^2)
2	2	39–45
3–4	3	51–57
4–5	4	61–70
over 6	5	73–83

('58-March)

Remarks: (1) Standard according to the revised Arrêté of May 1961.
(2) Area shows the net area of living space except wall, partition, staircase pipe-shaft.

Nation: FRANCE (2)
Source: L'habitation: tout ce qu'il faut savoir sur l'aide à la construction, 6me éditon, 1964.
Object: Public rental housing for lowest income.

HOUSING STANDARD

sq. m

No. of Rooms	1	2	3	4	5	6	7
Area H.L.M. Rental House	25–33	42–50	55–63	66–67	80–93	90–110	110–125

Room consists of Living room + Bedroom.

No. of Persons	Rooms	Area (m^2)
1	1	25– 33
2–3	1–2	25– 50
3–4	2–5	42– 93
5	6	90–110
6–7	6–7	90–125
8	7	110–125

This table is prepared from the conditions of occupation in H.L.M.

Remarks: (1) Standard according to the 'Journal Officiel' of 29th December, 1963.

Nation: ISRAEL
Source: National Report prepared for 28th IFHP World Congress
Object: Standards for the programme for abolishing substandard housing and of immigrant housing.

HOUSING STANDARD

sq. m.

No. of Persons	Gross Area
4–5	48
5–7	54
8	64

Remarks: The gross area includes outer walls, balconies and a staircase.

Nation: JAPAN
Source: National Report prepared for 28th IFHP World Congress
Object: Middle income group.

HOUSING STANDARD

(Area standard of J.H.C.) sq. m.

No. of Bedrooms	No. of Persons	Area
1	2	25.60
2	2–4	37.83
3	4–6	47.99

Remarks: (1) Area does not include the area occupied by staircase and balcony.

Nation: ITALY
Source: (1) 14 anni del Ina-Casa
(2) National Report prepared for 28th IFHP World Congress

HOUSING STANDARD

(1) Area standard of the houses built by INA-CASA sq. m

No. of Bedrooms	1	2	3	4	5
Initial standard	30	45	60	75	90
Corrected standard		50	70	90	110

(2) Area standard of the houses built by GESCAL sq. m.

No. of Bedrooms	1	2	3	4	5
Area standard		64	80	96	112

LATIN AMERICA
Source: (1) Proposed minimum standards for permanent low-cost housing and for the improvement of existing substandard areas.
Object: – intended as a guide to planners and architects designing projects which may be built utilizing loan funds from A.I.D., also intended as a yardstick for evaluating submitted to A.I.D. for approval.
– not 'desirable standards', but the minimum basic need of families of low income.

HOUSING STANDARD

For single family housing and multi-family housing

No. of Bedrooms	Area (sq. m.)	No. of Persons
1	39.66–33.96	2
2	47.56–41.86	3
3	54.56–48.86	4
4	61.56–55.86	5
5	70.96–64.66	6
6	77.96–71.66	7
7	84.96–78.66	8

Remarks: (1) The area occupied by a staircase, hallway, or closet shall not be included in the determination of required room areas.
(2) Living, dining and kitchen areas shall be increased by 10 % for each person in excess of five persons using the dwelling on a permanent basis.

Nation: NETHERLANDS
Source: Housing in the Netherlands (June 1964)
Object: The houses built with public subsidy by municipalities, house-building corporations and private persons.

HOUSING STANDARD

[1]) This accommodation capacity relates to the number of persons for whom a bed can be effectively placed in the bedrooms.
[2]) The area of a kitchen-living room must be at least 2 sq.m. greater than that prescribed for the living room alone of a dwelling of the same capacity.
[3]) If a second living room or a kitchen-dinette is designed, an area of 16 sq.m. will suffice. By a second living room is understood in this connection a room designed as an independent second living room, provided it is not the only room that fulfils the provisions for a bedroom for a married couple. A kitchen is regarded as a kitchen-dinette if the dimensions and the lay-out are such that it can comfortably contain a dining table and chairs; the area should be at least that stated in column 3 plus 0.5 sq.m. for each person for whom accommodation capacity is available (foot-note 1), but not less than 7 sq.m.
[4]) Insofar as the area of the space unit(s) intended for personal hygiene and for doing the family washing exceeds 1.5 sq.m., the excess area – up to a maximum of 2.5 sq.m. – is included in the figures shown in this column.

dwelling suitable to accommodate at least	floor area of the main living room at least [2])	floor area of the kitchen at least	floor area of the bedroom(s) at least	total floor area of the living room(s) + kitchen + bedroom(s) or of the kitchen-living room + bedroom(s) at least [4])	floor area of storage space (excl. cupboards) at least	
					(one family houses)	(per dwelling in more family houses)
						sq. m.
a. 2 persons (elderly people)	12	3	8	26.5	3	3
b. 2 persons (normal family)	14	4	9.5	32.0	3	3
c. 3 persons (elderly people)	14	3	14	34.0	4	4
d. 3 persons (normal family)	15	4	14	36.0	5	4
e. 4 persons (2 bedrooms)	16	4	16.5	39.0	5	4
f. 4 persons (3 bedrooms)	16	4	18.5	40.5	5	4
g. 5 persons	16	4	21	46.0	6	5
h. 6 persons	16	4	24.5	49.0	6	5
i. 7 persons	16	4	27	54.0	6	6
j. 8 persons	18	5	31.5	60.0	6	6
k. 9 persons	18	5	35	65.0	7	
l. 10 persons	18	6	37.5	70.0	7	
m.11 persons	18	6	42	75.0	8	
n. 12 persons	18	6	45 5	80 0	8	
o. 13 persons (and over)	18	6	48	84.0	8	

APPENDIX B

Dwelling Areas Projected (1973-1981)

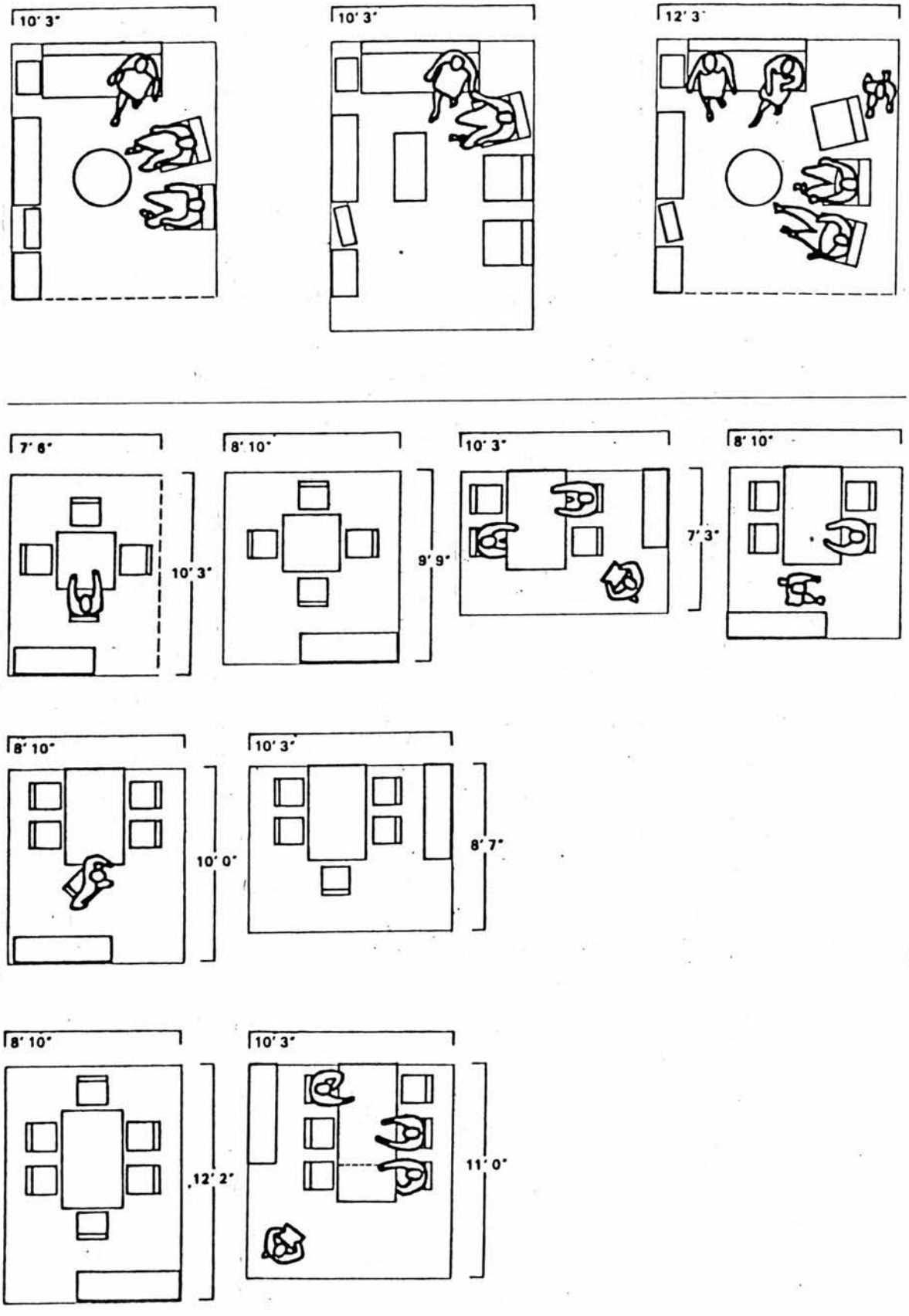
Korea

Years	Large Cities					Other Cities				
	A	B	C	D	E	A	B	C	D	E
1973	5.04	11.40	3.45	57.46	17.38	5.22	10.45	3,16	54.55	16.50
74	4.94	11.68	3.53	57.70	17.45	5.16	11.09	3.35	57.22	17.31
75	4.83	12.28	3.71	59.31	17.94	5.09	11.74	3.55	59.76	18.08
76	4.72	12.86	3.89	60.70	18.36	5.01	12.50	3.78	62.63	18.95
77	4.59	13.59	4.11	62.38	18.87	4.92	13.04	3.94	64.16	19.41
78	4.45	14.32	4.33	63.72	19.28	4.82	13.73	4.15	66.18	20.02
79	4.30	15.07	4.56	64.80	19.60	4.71	14.41	4.36	67.87	20.53
80	4.13	15.08	4.77	65.17	19.71	4.59	15.16	4.59	69.58	21.05
81	3.96	16.59	4.99	65.34	19.77	4.46	15.90	4.81	70.91	21.45

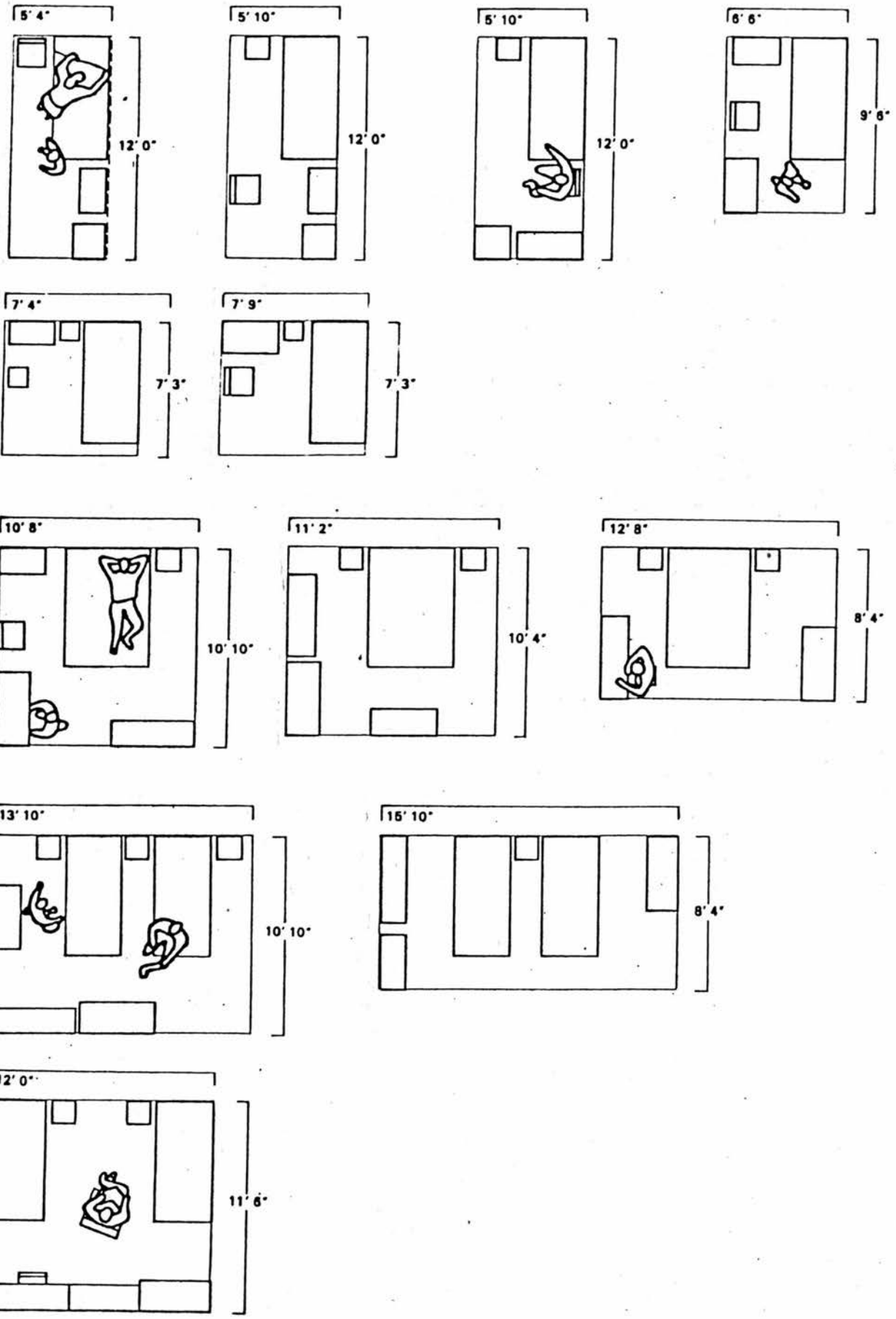
A: Average Household Size
B: Area(m^2) Per Person
C: Area(pyong) Per Person
D: Area(m^2) Per Dwelling
E: Area(pyong) Per Dwelling

Source: KIDRI, Study on Housing Policy Formulation in Korea. 1974,(P.133.)

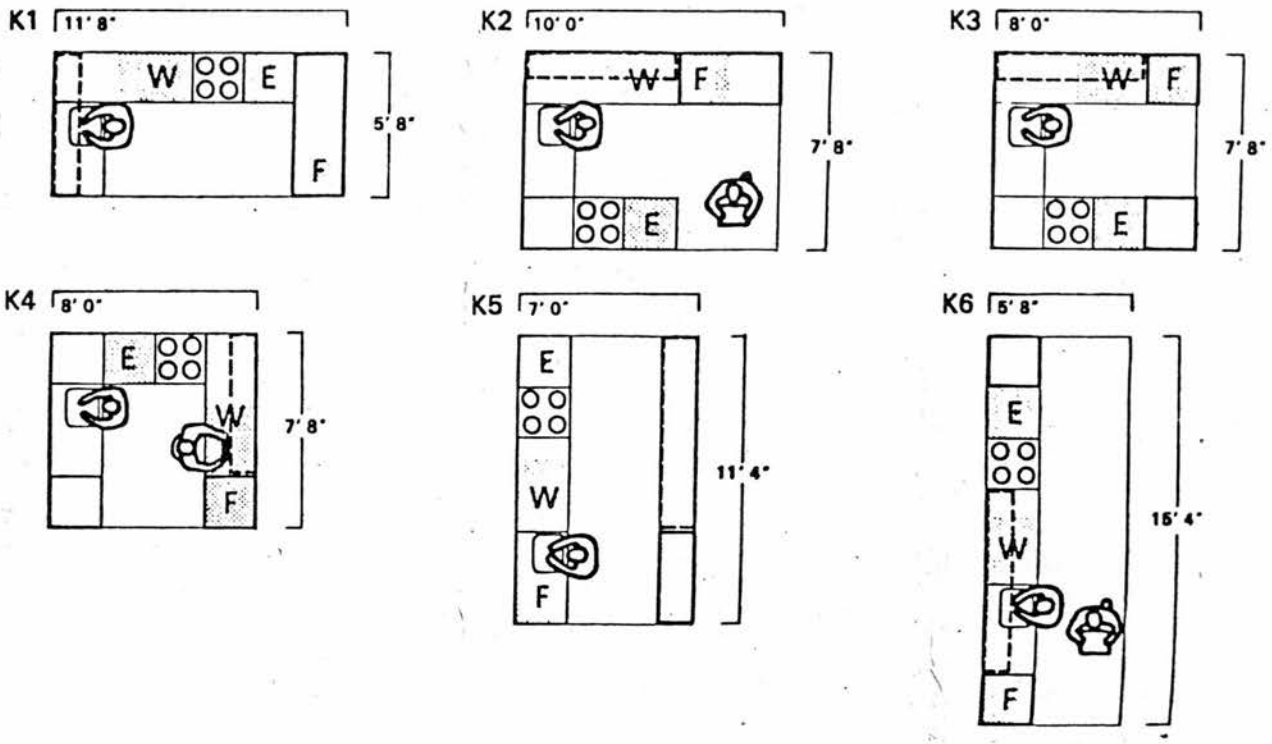
APPENDIX C Minimum Room Dimensions -1 (NBA 1967)

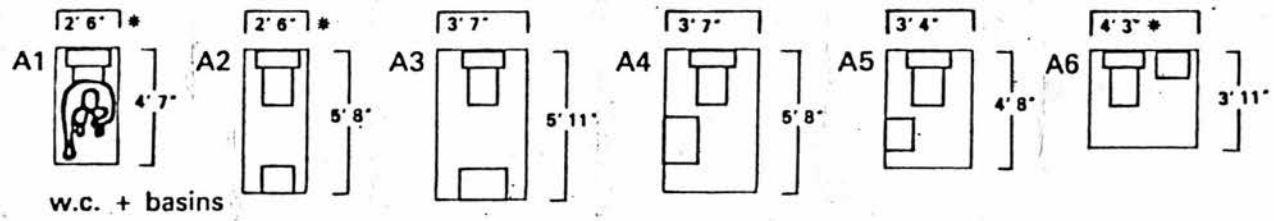


Minimum Room Dimensions -2 (NBA 1967)

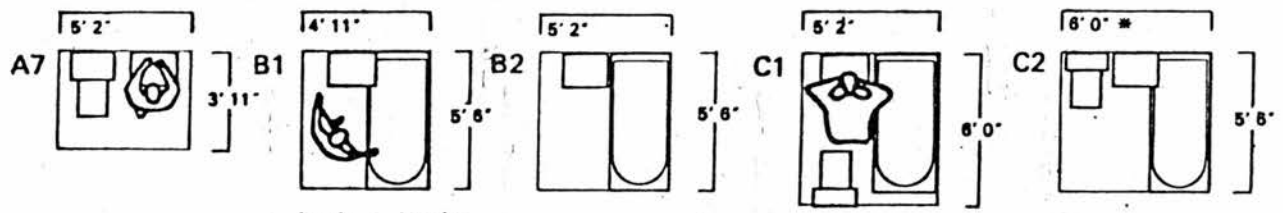


Minimum Room Dimensions -3 (NBA 1967)



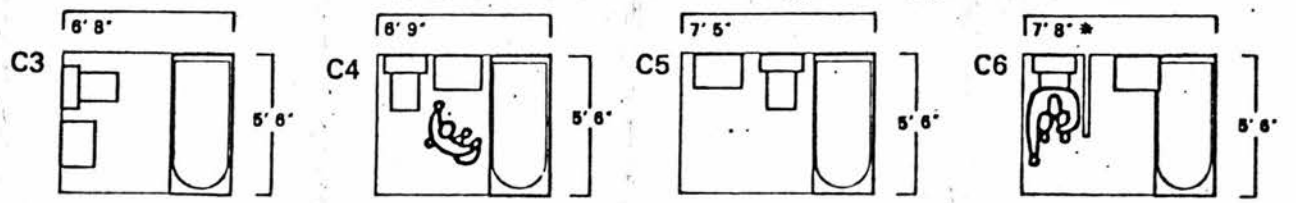


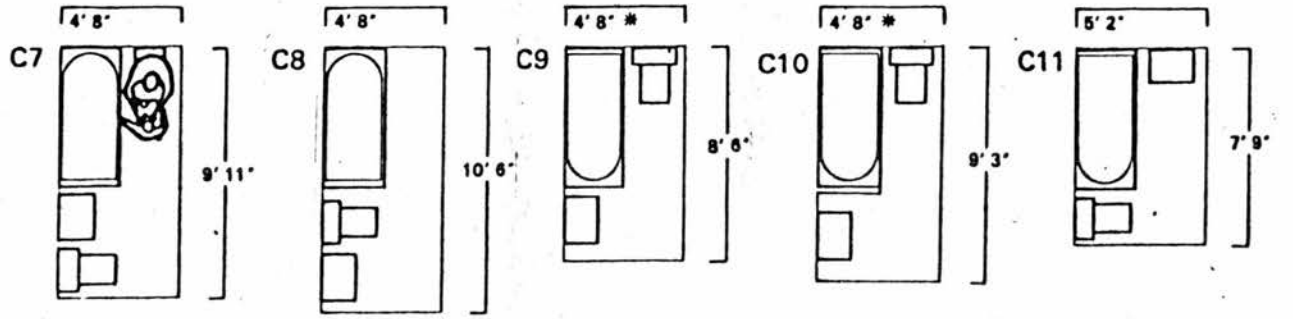
w.c. + basins



bath + basin

bath + basin + w.c.

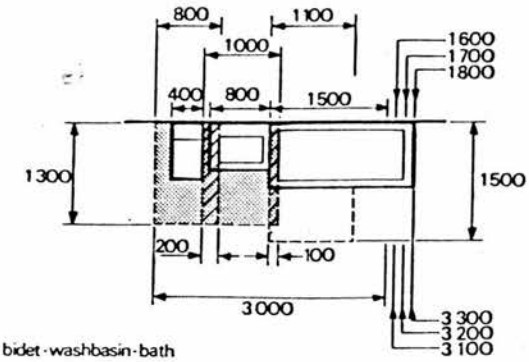




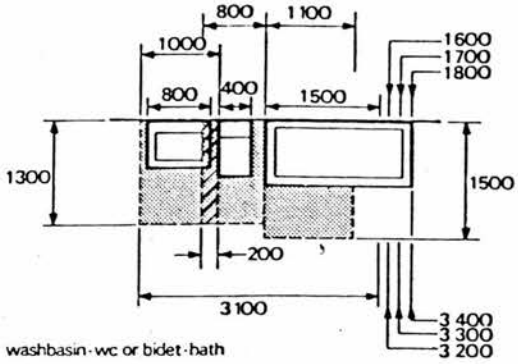
bath + basin + w.c.

APPENDIX D Overlap Space Usage in Bathroom/W.C.

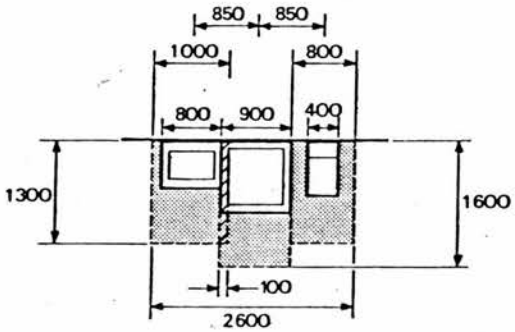
assemblies on one backing wall



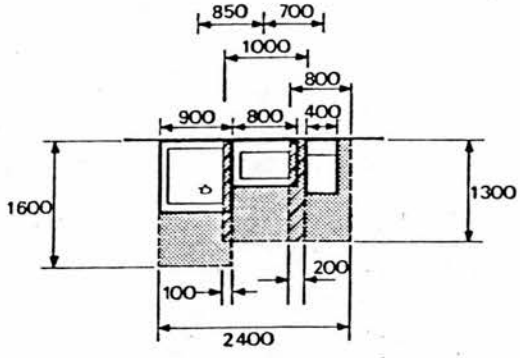
wc or bidet·washbasin·bath



washbasin·wc or bidet·bath

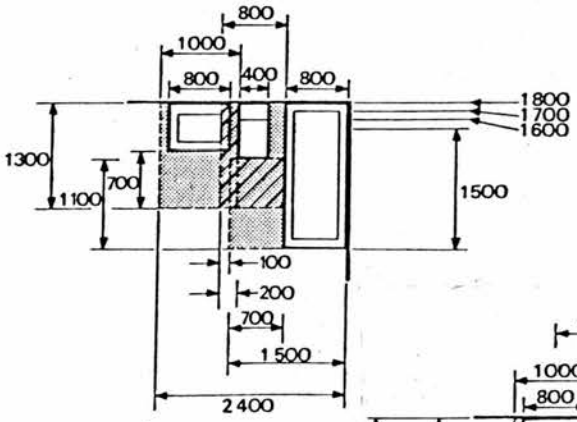


washbasin·shower·wc or bidet

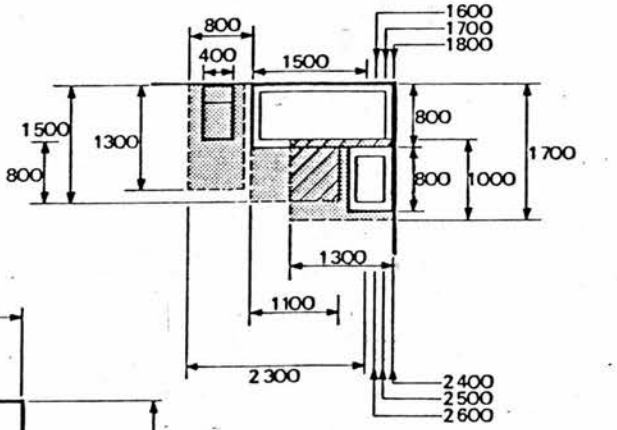


shower·washbasin·wc or bidet

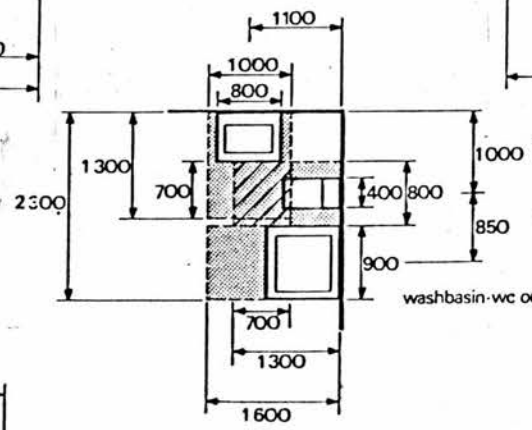
assemblies on two backing walls at right-angles



washbasin·wc or bidet·bath

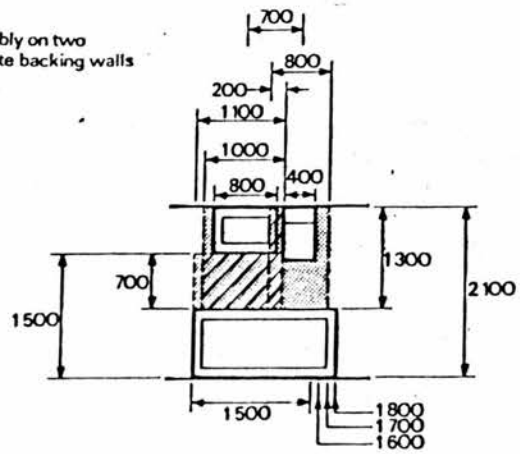


wc or bidet·bath·washbasin



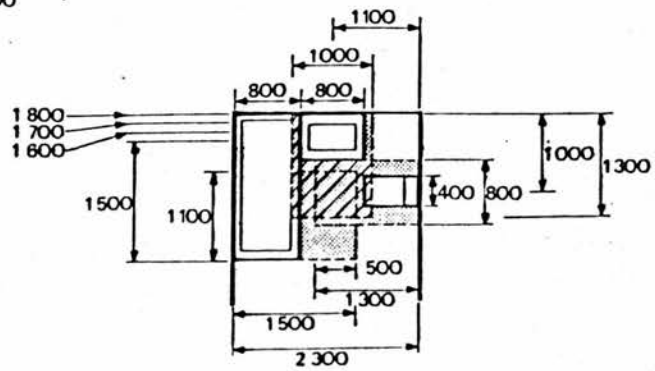
washbasin·wc or bidet·shower

assembly on two opposite backing walls



washbasin·wc or bidet·bath

assembly on three backing walls in 'u' shape



bath·washbasin·wc or bidet

(all dimensions in millimetres)

Source: International Organisation for Standardisation(ISO), DOE Cons., 21/3/'77

APPENDIX E Housing Space Standards (U.K. 1969)

MANDATORY MINIMUM STANDARDS FOR LOCAL AUTHORITY HOUSING

General: Appendix 1 to Circulars 36/67 (England) and 28/67 (Wales)—metric version

The housing standards set out in this appendix are the principal standards recommended as minima by the Parker Morris Committee appointed as a subcommittee by the minister's Central Housing Advisory Committee and recommended in its report *Homes for today and tomorrow* published by HMSO in 1961. Not every metric measurement shown in this appendix is a precise equivalent of the corresponding imperial measurement.

The new standards are based on minimum floor areas according to the intended size of the household and, in accordance with the committee's recommendation, compliance with minimum room sizes is no longer required. However, it is essential that designers have full regard to user requirements and respect the requirements and variety of home activities as reflected in the amounts of furnishing normally required and its convenient arrangements. For this purpose designers are referred to Design Bulletin 6 *Space in the home** and also to additional information set out in E below. The new standards relate to all schemes of public authority housing other than (*a*) flatlets for old people and (*b*) single persons' accommodation provided with common-rooms and other communal facilities. The standards do, however, relate to single-person dwellings where communal facilities are not provided. For self-contained dwellings for old people only the space standards apply.

A Plan arrangement

Mandatory from 1 January 1969

1 A dwelling shall have (i) an entrance hall or lobby with space for hanging outdoor clothes and (ii) for three-person and larger houses and three-person and larger dwellings served by a lift or ramp a space for a pram (1400mm × 700 mm).

2 Except in one-person or two-person dwellings access from bedroom to the bathroom and a WC shall be arranged without having to pass through another room.

3 The kitchen in a dwelling for two or more persons must provide a space where casual meals may be taken by a minimum of two persons—see also E1.

4 In addition to kitchen storage, the sink and space for a cooker, a minimum of two further spaces shall be provided in convenient positions to accommodate a refrigerator and a washing machine. The latter may be in the kitchen or in a convenient position elsewhere. These spaces may be provided under work top surfaces.

5 Most house layouts now provide for public access to both sides of the house, but where public access to a house of three or more persons is from one side only, a way through the house from front to back shall be provided and this must not be through the living-room. In such cases the dustbin compartment shall be on the front.

6 Access to dwellings shall not involve a climb through more than two storeys to the front entrance doors.

* Sections of Design Bulletin 6 are included in this handbook. See p140, 141

Space

Mandatory from 1 January 1969

Standards A home for occupation for the number of people shown in the table below shall be designed to provide areas of net space and general storage space not less than those set out in the table and fulfilling the conditions in the notes following the table. N = net space (note 1); S = general storage space (note 2).

		Number of people (ie bedspaces) per dwelling						
		1 (m²)	2 (m²)	3 (m²)	4 (m²)	5 (m²)	6 (m²)	7 (m²)
Houses								
One-storey	N	30	44·5	57	67	75·5	84	
	S	3	4	4	4·5	4·5	4·5	
Two-storey: semi-detached or end	N				72	82	92·5	108
	S				4·5	4·5	4·5	6·5
Intermediate terrace	N				74·5	85	92·5	108
	S				4·5	4·5	4·5	6·5
Three-storey (excluding garage, if built-in)	N					94	98	112
	S					4·5	4·5	6·5
Flats	N	30	44·5	57	70*	79	86·5	
	S	2·5	3	3	3·5	3·5	3·5	
Maisonettes	N				72	82	92·5	108
	S				3·5	3·5	3·5	3·5

*(67 if balcony access) **Tolerance:** Where dwellings are designed on a planning grid and not otherwise a maximum minus tolerance of 1½ per cent shall be permitted on the net space

Note 1 Net space is the area on one or more floors enclosed by the walls of a dwelling measured to unfinished faces. It includes the space, on plan, taken up on each floor by any staircase, by partitions and by any chimney breast, flue and heating appliance and the area of any external wc. It excludes the floor area of general storage space (s in table) and dustbin store, fuel store, garage or balcony and any area in rooms with sloping ceilings to the extent that the height of the ceiling does not exceed 1·5m and any porch, lobby or covered way open to the air.

In the case of a single access house, any space within a store required to serve as access (taken as 700mm wide) from one side of a house to the other shall be provided in addition to the areas in the table.

Note 2 General storage space is the space which shall be provided *exclusive* of any dustbin store, fuel store, pram space located in a store and, in the case of a single access house, any space within a store required to serve as access (taken as 700mm wide) from one side of a house to the other.

For *houses* some of the storage space may be on an upper floor but at least 2·5m² shall be at ground level.

Where some of the storage space is provided on an upper floor, it shall be enclosed separately from linen or bedroom cupboards; it shall be accessible from the circulation space or from a room if conveniently accessible in relation to furnishing.

Where there is a garage integral with or adjoining a house, any area in excess of 12·0m² shall count towards the general storage provision.

For *flats and maisonettes* not more than 1·5m² may be provided outside the dwelling and any area in excess of 12·0m² which is provided in a garage integral with or adjoining the dwelling shall count towards this 1·5m².

Fuel storage (*excluded* from the table) where required, shall be a minimum of:

For houses	1·5m² where there is only one appliance
	2·0m² where there are two appliances or in rural areas

For flats and maisonettes 1·0m² if there is no auxiliary storage.

Note 3 Area per dwelling for form TC2 is the sum of the net space, the general storage space and where applicable:

(*a*) in the case of a single access house, any space within a store required to serve as access (taken as 700mm wide) from one side of a house to the other;

(*b*) fuel store;

(*c*) pram store where provided *outside* the dwelling (where pram space is additional to general storage).

Areas are measured to the unfinished faces of the main containing walls on each floor of the dwelling and include the space, on plan, taken up by private staircases, partitions, internal walls (but not 'party' or similar walls), chimney breasts, flues and heating appliances. The area of the dwelling includes the area of the tenant's storage space whether located within the dwelling or elsewhere.

It excludes any space where the height to the ceiling is less than 1·5m (eg areas in rooms with sloping ceilings, external dustbin enclosures);

any porch, covered way and so on open to the air;

any garage *except* that, where a garage is integral with or adjoining the dwelling, the excess over 12·0m² qualifies as storage space and as part of the area of the dwelling;

all balconies (private, escape and access) and decks;

all public access space (eg tunnel passages, communal entrances, staircases, corridors);

all space for communal facilities or services;

all space for other-than-housing purposes (eg commercial).

Fittings and equipment

The standard at 1(c) will be mandatory as from 1 January 1969. The date on which the other standards in this section might become mandatory has not yet been fixed.

1 The wc and washbasin provision shall be as set out below:

(*a*) In one-, two- and three-person dwellings, one wc is required, and may be in the bathroom.

(*b*) In four-person two-storey or three-storey houses and two-level maisonettes, and in four-person and five-person flats and single-storey houses, one wc is required in a separate compartment.

(*c*) In two- or three-storey houses and two-level maisonettes *at or above* the minimum floor area for five persons, and in flats and single-storey houses *at or above* the minimum floor area for six persons, two wcs are required, one of which may be in the bathroom.

(*d*) Where a separate wc does not adjoin a bathroom, it must contain a washbasin.

2 *Linen storage*

A cupboard shall be provided giving 0·6m³ of clear storage space in four-person and larger dwellings or 0·4m³ in smaller dwellings.

3 *Kitchen fitments*

Kitchen fitments comprising enclosed storage space in connection with:

(*a*) preparation and serving food and washing-up;

(*b*) cleaning and laundry operations;

(*c*) food

shall be provided as follows:

Three-person and larger dwellings	2·3m³
One- and two-person dwellings	1·7m³

Part of this provision shall comprise a ventilated 'cool' cupboard and a broom cupboard. The broom cupboard may be provided elsewhere than in the kitchen.

Where standard fitments are used the cubic capacity shall be measured overall for the depth and width, and from the underside of the work top to the top of the plinth for the height.

Work tops shall be provided on both sides of the sink and on both sides of the cooker position. Kitchen fitments shall be arranged to provide a work sequence comprising work top/cooker/work top/sink/work top (or the same in reverse order) unbroken by a door or other traffic way.

4 *Electric socket outlets* shall be provided as follows:

Working area of kitchen	4
Dining area	1
Living area	3
Bedroom	2
Hall or landing	1
Bedsitting-room in family dwellings	3
Bedsitting-room in one-person dwellings	5
Integral or attached garage	1
Walk-in general store (in house only)	1

Space heating

Mandatory from 1 January 1969

The minimum standard shall be an installation with appliances capable of maintaining the kitchen and circulation spaces at 13°c, and the living and dining areas at 18°c when the outside temperature is — 1°c.

Furniture

Mandatory from 1 January 1969

All dwelling plans must show the furniture drawn on and should be designed to accommodate furniture as set out below:

1 *Kitchen*

Small table unless one is built-in

2 *Meals space*

Dining-table and chairs

3 *Living space*

Two or three easy chairs

Settee

Tv set

Small tables

Reasonable quantity of other possessions, such as radiogram, bookcase

4 *Single bedrooms*

Bed or divan (2000mm × 900mm)

Bedside table

Chest of drawers

Wardrobe or space for cupboard to be built-in

5 *Main bedrooms*

Double bed (2000mm × 1500mm)—and where possible two single beds* (2000mm × 900mm) as an alternative

Bedside tables

Chest of drawers

Double wardrobe or space for cupboard to be built-in

Dressing-table

6 Other double bedrooms
Two single beds (2000mm × 900mm) each
Bedside tables
Chest of drawers
Double wardrobe or space for cupboard to be built-in†
Small dressing-table
Note Spaces for wardrobes, or space for cupboards to be built-in later should be on the basis of 600mm run of hanging space per person. The space provided for a cupboard depth should be not less than 550mm internally.

F Play space

The date on which this might become mandatory has not yet been fixed

Play space must be provided on schemes of 200 persons per hectare and above on the basis of 1·5m² to 2·0m² per bed space, with a minimum of 1·0m² in exceptionally favourable circumstances, such as where an estate has existing playgrounds easily accessible in the immediate vicinity.

The housing cost yardstick—appendix II to circular 36/67

Metrication of densities

The cost table in appendix II to Circular 36/37 may still be used for calculating the housing cost yardstick figure applicable to any given metric scheme. The density in persons per hectare should first be converted to persons per acre by multiplying by 0·405 after which the table may be used in the normal way.

Example
In order to apply the yardstick table, find the equivalent in persons per acre of 375 persons per hectare:
375 × 0·405 = 151·875 ie 152 persons per acre.

Car spaces per acre
The same factor (0·405) may also be used to convert car spaces per hectare to car spaces per acre. This figure will be needed in order to establish the 'equivalent higher density' applicable to schemes incorporating more than thirty car spaces per acre—see paragraph 16 of appendix II to Circular 36/67.

Notation: In general, building dimensions such as ceiling heights and main areas are expressed in metres and furniture sizes or furniture spaces in millimetres.
This is the end of the extracts from Circular 1/68.

* Where single beds are shown they may abut or where alongside walls must have a space of 750mm between them. See also note opposite.
† May be provided within easy access outside room

Critical dimensions

Table I is freely translated from standards adopted by the Architects Department of Wates Ltd in designing residential accommodation, which experience has shown to be desirable minima. The metric dimensions are not necessarily exact equivalents of the imperial figures.

Table I Critical dimensions: recommended minima

Item		Recommended minimum dimension (mm)	Notes
Doorsets (Door and frame)	Front doors	900	Preferably 900mm
	Other doors generally	800	
	Bathroom, wc or cupboards	600	
Entrance	Lobby	1500	Least dimension
Staircase openings	Single flight	900 width 2700 length	Preferably 1000mm with maximum rise 195mm and minimum going 220mm
	Double flight or stairs plus landing	1800 width 2100 length (dogleg)	
Living Room	Possible 3300mm (min) (depending on access and furniture arrangement)		
Dining Room or Recess	Possible 2700mm (min) (depending on access and furniture arrangement)		
Kitchen	600mm fittings on one side only	1800 (min)	Could possibly go down to 1700 and 2300 in small and 1 and 2 person dwellings
	600mm fittings on both sides	2400 (Min)	
Bathroom	Bath and W.C. or bath and wash basin side by side	1500 (Min)	
	Bath basin and W.C. side by side	2200 (Min)	
	Bath end on or basin sideways	2500 (Min)	
	W.C. sideways	2400 (Min)	

Bed sizes

The National Bedding Federation Ltd intends to launch new standard sizes in January 1972.
Four basic sizes will be introduced:
Standard beds
Single: 1000 mm × 2000 mm
Double: 1500 mm × 2000 mm
Replacement beds
Single: 800 mm × 1920 mm
Double: 1350 mm × 1920 mm

Space requirements related to activities

Drawings **26.3** to **26.38** are reproduced from Design Bulletin 6 *Space in the home* (metric edition) by permission of the MOHLG and the Controller of HMSO (Crown copyright).
The following notes are extracted from *Bord.*

Eating area in the kitchen
A rectangular table is the best shape for a small kitchen, with a minimum width of 750mm.
If the dining area is bounded by walls or work tops on both sides of the table, total width should not be less than 2300mm; or 2600mm if there needs to be free passage behind the chair on one side.

Allow: 700mm between the oven and a chair in use;
800mm between the most commonly used work top and a pushed-in chair.

Recommended table sizes:

Two people	:	750mm × 750mm
Three people	:	750mm × 1000mm
Four people	:	750mm × 1200mm
Five people	:	750mm × 1350mm

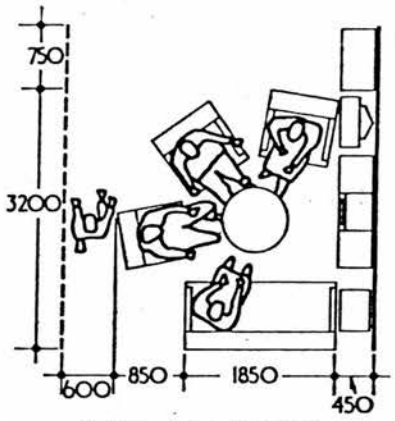
Eating area in the living-room or dining-room

The table should be at least 850mm wide, preferably extendable.

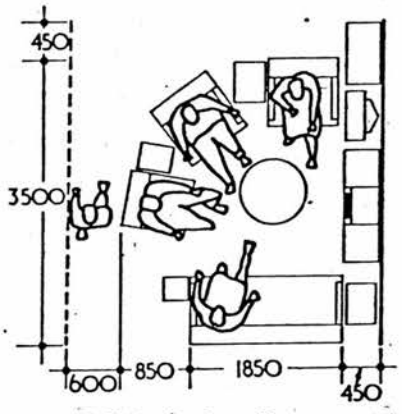
Recommended rectangular dining-room table sizes (before extension):

Three to four people	:	850mm × 1050mm
Four people	:	850mm × 1200mm
Five people	:	850mm × 1350mm
Six people	:	850mm × 1500mm
Seven people	:	850mm × 1800mm

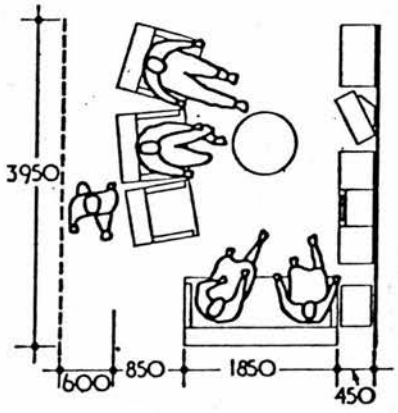
LEISURE (five-person family)



Eating at a coffee table

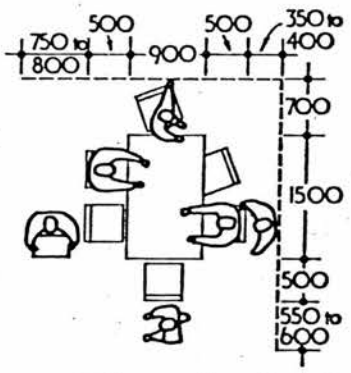


Talking and reading

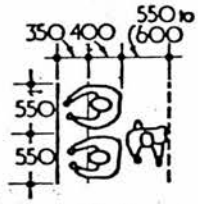


Looking at tv

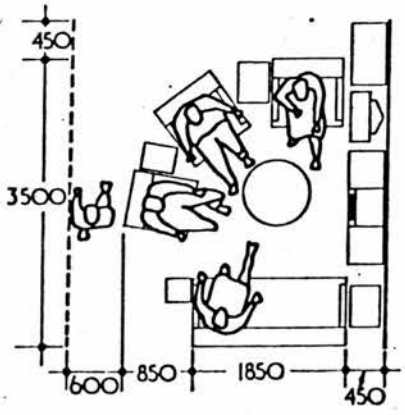
EATING



Sitting at table and moving around

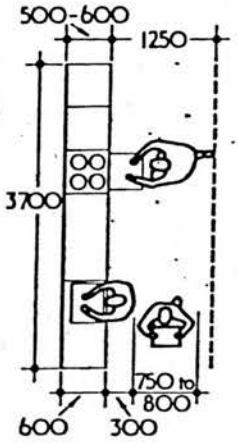


Sitting at work top with person passing

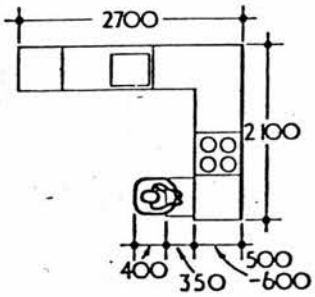


Talking and reading

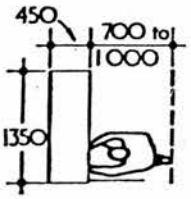
FOOD PREPARATION



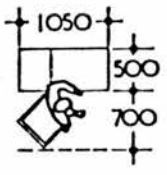
At sink: passing with tray: at oven (new BS in preparation will supersede depth and length of fitments in **26.3** *and* **26.4**)



Sitting at pull-out work top

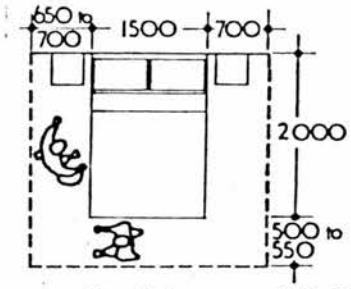


Taking things from a sideboard or low cupboard

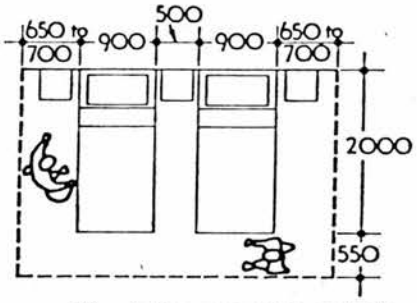


Getting up from a table, desk or writing bureau

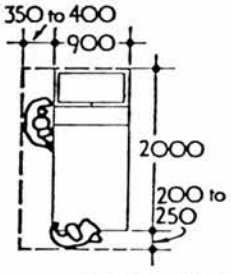
SLEEPING



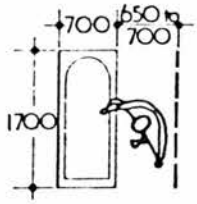
Circulation around double bed



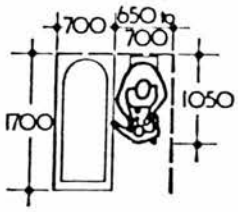
Circulation around twin beds



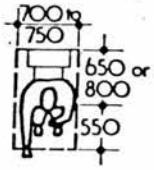
Making a bed



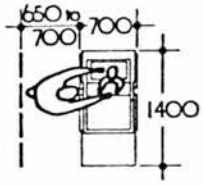
Drying after a bath



Drying a child after a bath

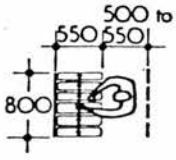


Using wc (low level cistern)

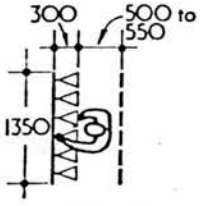


Getting pram ready

Helping on with a coat

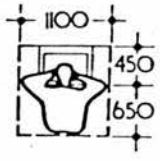


Hanging coats on hangers

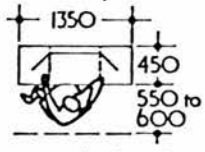


Hanging coats on hooks

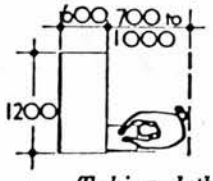
PERSONAL CARE



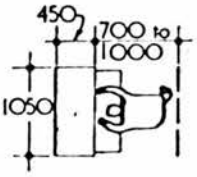
Face washing



At dressing-table

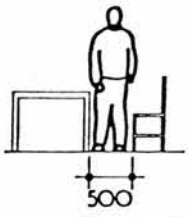


Taking clothes from wardrobe drawer

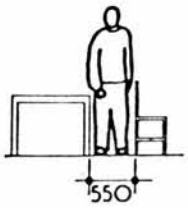


Taking clothes from chest of drawers

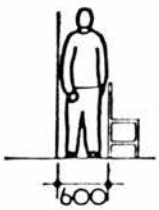
CIRCULATING



Passing between two pieces of furniture one of which is at level lower than table height



Passing between a piece of furniture at or lower than table height and taller piece of furniture or wall



Passing between tall piece of furniture and wall

Note: The dimensions shewn of any furniture or fittings may require revision as new dimensionally co-ordinated metric standards are published by BSI

Kitchen storage

Shelf and drawer storage

The information in this section is based on an investigation into shopping habits and storage requirements of households, carried out by the Council of Scientific Management in the Home in 1963/64 and on a subsequent study of the space requirements of stored items made by Queen Elizabeth College, the University of London.

Table III lists the area of shelf storage required; table IV lists the amount of drawer storage required by the average family.

Table Space requirements: Shelves

Item	Storage (m^3)	Shelf length (mm)	Shelf depth (mm)	Vertical clearance (mm)
Dry goods*	0·5	2800 250	150 230	200 330
Tinned and bottled goods	0·2	1100 300	150 150	150 300
Drinks	0·3	Length immaterial	150 minimum	350
Bread, cake, biscuits	0·3 + bread bin base 300 × 250mm	900	300	150
Pet foods	0·05	300	150	200
Dairy goods, meat, fish, poultry, frozen foods	0·9			
Table china and glass	1·6	3250 450	280 280	150 200
Cooking china and glass	0·45	1000 1600	450 280	150 and a small amount of 250
Saucepans, frying pans, and so on	0·7	760 1700	280 280	150 300
Miscellaneous china and glass	0·25	900	280	300
Cookery books	0·05	300	150	230
Empty jars and bottles	0·2 in any form			

* Figures given are for items stored in packets as purchased. If they are stored in canisters the area required could be as much as 0·8m^3 with 3900mm of 150mm deep shelving and 1100mm of 230mm

Table Space requirements: Baskets, drawers

Item	Method of storage	Number required	Storage area (m^3)	Dimensions (mm)
Fruit and vegetables	Baskets	2	0·4	480 × 380 × 80
Table cutlery	Drawer	1	0·8	450 × 450 × 80
Kitchen cutlery and equipment*	Drawers	1½ ½	0·8	450 × 450 × 100 450 × 450 × 150
Baking tins	Drawers	1½	0·8	450 × 450 × 150

* Including bread board, chopping board, rolling pin

Other storage requirements

In addition, provide space for the following:

Cleaning materials and equipment

Door height cupboards 760mm wide × 400mm deep

Vacuum cleaner:

upright model approx 350mm × 400mm } plus
cylinder model approx 600mm × 200mm } attachments

Trays

Space of 400mm deep × 150mm wide × 600mm high.

Kitchen linen

At least one drawer 450mm × 450mm × 120mm deep.

Summary

Tables V and VI summarise storage requirements of a kitchen.

Tables V and VI are for families of three, four and five people, but smaller families usually require the same amount of space for most items. Total storage area from tables V and VI is 8·3m^3. Compare this with the three-to-four bedroom house in table VII.

Table Area of shelf storage: Summary

Item	Area (m^3)
Food, china and glass, saucepans, frying-pans, bread board, chopping board, and so on	4·5
Refrigerator storage	0·9
Broom cupboard	0·7
Bucket and soaps cupboard	0·5
Total area	6·6

Table Area of drawer storage: Summary

Item	Area (m^3)
Fruit and vegetables, table cutlery, kitchen cutlery and equipment	1·3
Linen	0·4
Total area	1·7

Table BS 3705:1964 Recommendations for kitchen provision (approximate metric conversions)

Size of home (number of bedrooms)	Area (m^3)		
	Shelves	Drawers	Total
1	4·6	0·9	5·5
2	5·6	1·1	6·7
3 to 4	7·0	1·4	8·4

MOHLG storage requirements

By comparison, MOHLG requirements for housing in the public sector are as follows:

Kitchen fitments comprising enclosed storage space in connection with:

(*a*) preparation and serving of food, and washing up;

(*b*) cleaning and laundry operations;

(*c*) food:

Three-person and larger dwellings 2·3m^3

One- and two-person dwellings 1·7m^3

Critical dimensions are shown under para 4 of this section, p140.

Clothes storage

Storage requirements will vary from family to family. Many of the recommendations in this section are taken from Swedish sources, except for table VIII which summarises the requirements of the MOHLG and the New Scottish Housing Handbook.

If possible, space should be provided for storage of seasonal and rarely used clothes (see table IX).

Wardrobe, shelf and drawer dimensions are given in **26.39 to 26.41.** Shelf or drawer storage for stockable clothes should be provided: allow about 0·3m³ for men and 0·27m³ for women.

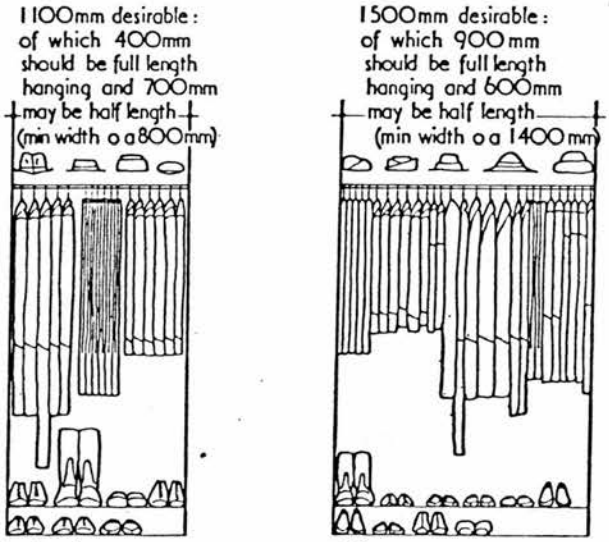
Note that in tables IX and X and in **26.39** the Swedish clothing inventory includes more heavy winter garments than in the UK.

Linen storage

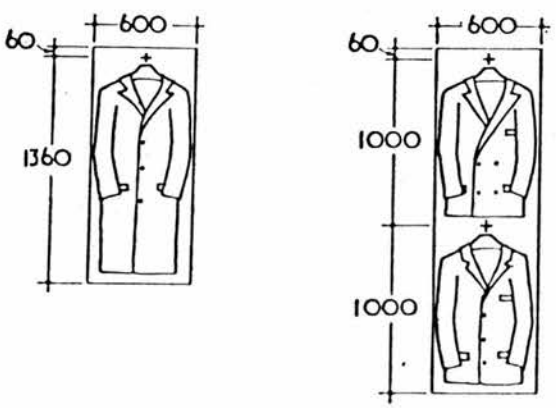
Suggested dimensions for linen cupboards are shown in table X and alternative arrangements for linen storage in

The MOHLG requires a cupboard giving 0·6m³ clear storage space (four-person or larger dwelling) and 0·4m³ in smaller dwellings.

The New Scottish Housing Handbook recommends the same standards as MOHLG.



Optimum hanging space for a family of four



Dimensions of wardrobes for full and half-length hanging

Table Recommended sizes for built-in wardrobes

	Homes for today and tomorrow	New Scottish Housing Handbook
Main bedroom	No recommendation	600mm run of hanging space per person, with minimum internal depth of 550mm.
Other bedrooms	600mm of rail per occupier not less than 550mm deep	600mm × 600mm wardrobe cupboard

Table Recommended lengths of hanging rail for seasonal and occasional clothes

For seasonal clothes	
Family of two	1000mm
Family of four	1600mm
For clothes not in use	
Family of two	500mm
Family of four	1000mm

Table Suggested dimensions for linen cupboard (Swedish)

Size of household	No of shelves	Width (mm)	Depth (mm)	Height (mm)
	5	550	300	850
	8	550	300	1500
	8	550	300	2000

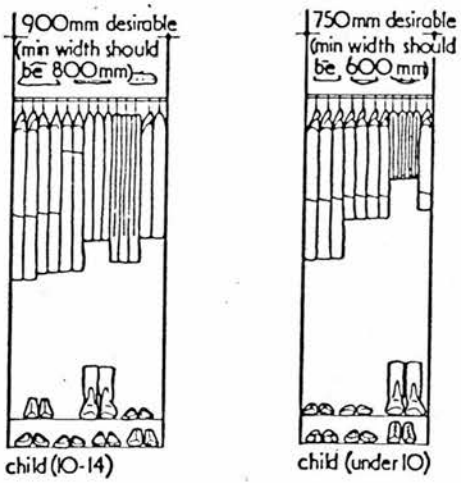
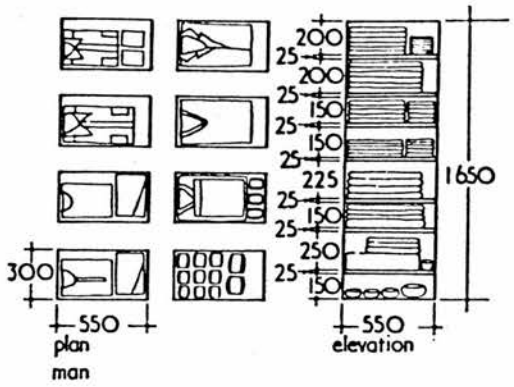
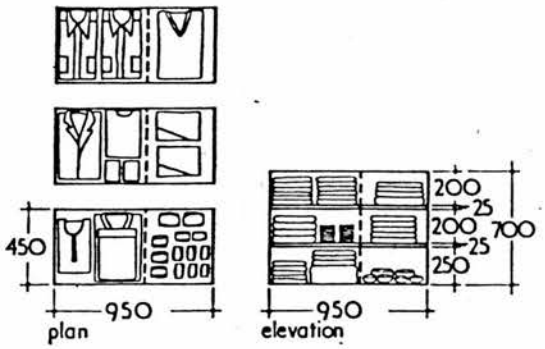
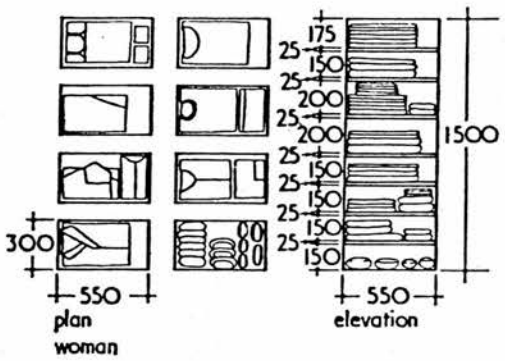


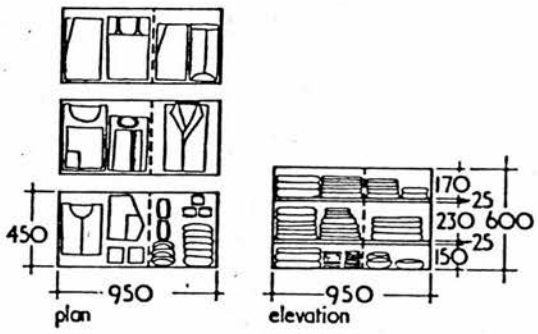
Table Dimensions of common items of linen

	Number	Width (mm)	Depth (mm)	Height (mm)
Sheet (linen):	5	610	330	15
2350 × 2540mm—double	6	340	310	30
Sheet (linen):	4	610	460	15
1800 × 2540mm—single	5	610	230	30
Sheet (flannelette):	4	560	510	30
2000 × 2300mm—double	5	560	260	50
Blanket:	4	610	560	80
2300 × 2540mm—double	5	610	280	150
Blanket:	4	610	510	80
2000 × 2540mm	5	610	260	150
Blanket:	4	560	460	80
1800 × 2300mm—single	5	560	230	150
Pillow Case	2	530	220	15
Pillow	1	710	430	150
Hand towel: 600 × 400mm	2	200	310	30
Face towel: 500 × 1000mm	3	260	260	30
Bath towel: 920 × 1370mm	4	360	230	90

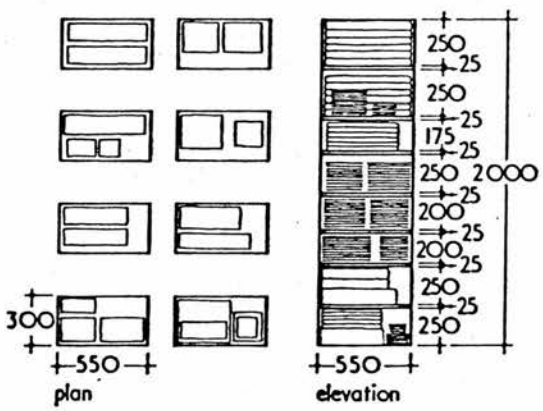


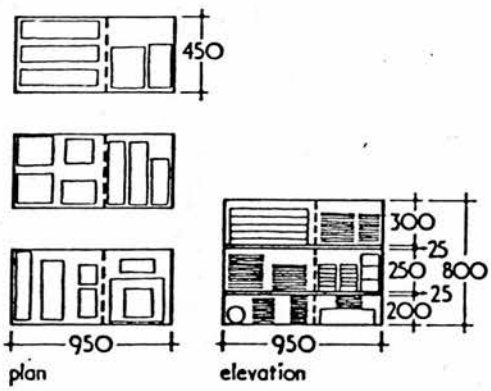






Shelf or drawer storage





Alternative arrangements of linen stored by family of five

APPENDIX - F

A Study of Space for Storage & Equipment in Housing of All Strata in Urban Areas in Korea.[1]

Lee, In - Hi [2]. Song, Jong - Suk [3]

Abstract

Due to limitations of budget and personal, the sampling was limited to the Seoul area.

The research methodogy involved in this survey consisted of field survey analysis of actual space, calculation of adequate storage volume, and design of layout for each type of storage.

The housing survey was conducted from October 1974, to April 1975.

Ninety six house holds in Seoul city were randomely selscted according to the financial status, and dwelling types.

Financial levels were classified as upper, middle and lower classes according to monthly average income of subjects.

The findings are as follows:

1. The house and storage volumes were directly related to the number in the family, and their income, and dwelling type.

In the case of independent housing, it was found that upper class famlies has a monthly average income of 428,000 won, with 245m² of average dwelling area; middle class, 168,000 won, with 87.4m²; and lower class, 53,000 won, with 34m².

In the case of apartment dwellings, upper class, 368,000 won with 117m²; middle class, 168,000 won, with 71.3m² lower class 60,000 won, with 33m².

2. The average number of persons in the ninety six households surveyed was 6 persons at independent houses, and 4.8 persons at apartments.

The rate of complex and nuclear families in the households surveyed was tabulated 36.5 : 63.5; and the difference in the number in the family due to the levels of income and dwelling type was found to be from 0.4 to 2.4 persons.

3. The actual average storage volume per person ranged form 2.1 to 7m³ for the individual house and from 2.1 to 6.4m³ for the apartment houses and was related to theire classification of financial status which indicates almost three times difference between higher and lower classes, for storage volume.

4. The actual storage volume of the total dwelling volume was from 8.8 to 13.4 percent.

The average storage furniture volume (chests, cabinets, etc.) in the houses compared with total average dwelling volume was from 9.9 to 14.7 percent.

The use was 112% (overflow) at lower class dwellings while approximately 90% at others.

The storage of clothing and garments required from 33.1 to 50.1% to 50.1% of the total volume of storage.

5. Each cycle of clothing management (purchasing, discarding or remodeling of clothes) required 2.6 years.

During longer cycles, such as up to 8 cycles (20.8 years) for general handling, the increased storage volume of clothes and garments is calulated at no more than 150% of the normal middle class starting outfit.

The conclusion as follows;

According to Korean life haibts, the author has indicated the required quantities of clothing, bedding quilts and dinnerware for an independent middele class home.

The decreasing amount of main storage volume resulting from the develepment of social economy and culture will come to 28% : needed clothing storage space will decrease by 10%, bedding by 55% and dinnerware by 23% in the next 10 to 20 years. Thus 28% additional space will become available for other use.

The author proposes the following as adequate middle class independent house storage space:

Living room 1.15~3.2m³ per household; Clothing & garments, 1.51m³ per person; Bedding, 0.9m³ per person; Kitchen cabinet, 1.7m³ per household; Midcelloneous storage 5.7m³ per household; Food storage, 5.7m³ per household.

On this basis, the author sketches proposals for each storage unit and, finally, has prepared some sample middle class housing plans to illustrate the actual utilization of this study.

1 Korean Architectural Journal 10/1975 (pp. 11-18)

2 Professor. Dong duk Home Economic College

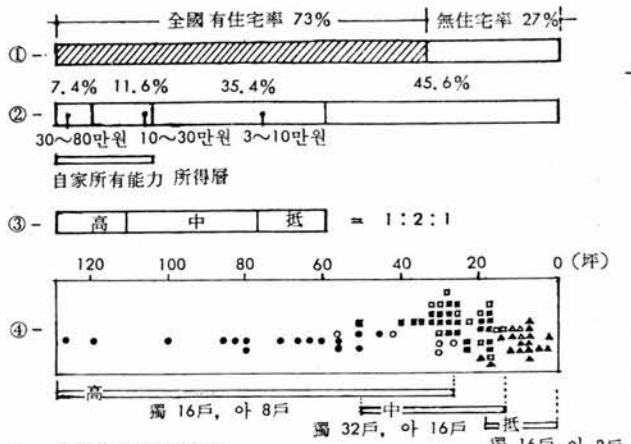
3 Professor. Yonsei University

所得階層別 都市型 住宅의 收納 空間에 대한 組系 (I)—(II)

A Study of Space for Storage & Equipment in Housing of All Strata in Urban Areas in Korea. 1975

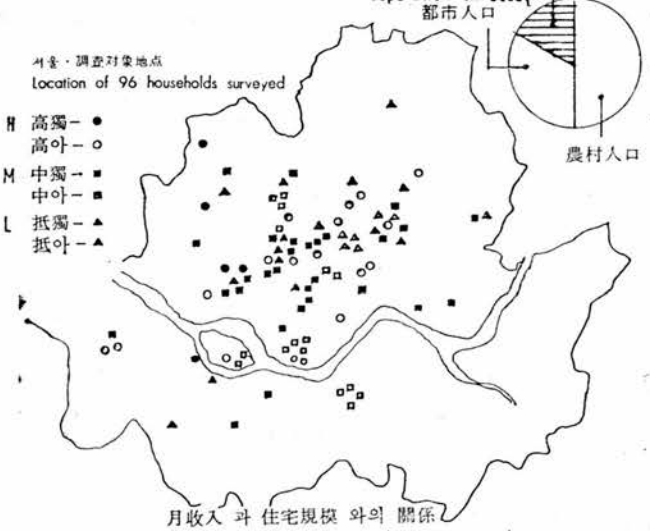
筆者案 Jong Suk Song In Hi Lee

全國 住宅統計 및 調査對象住宅 所得層 規模分類
Relation between housing situation of whole country & 96 H of surveyed

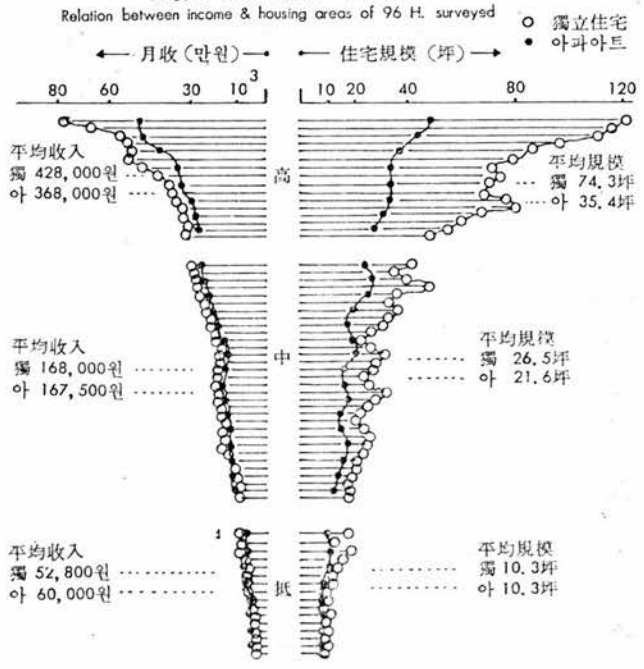


①- 全國住宅統計(1973)
②- 全國所得階層 統計(國稅廳 1973)
③- 서울 調査對象所得階層分類
④- 調査 住宅構造 및 規模分類

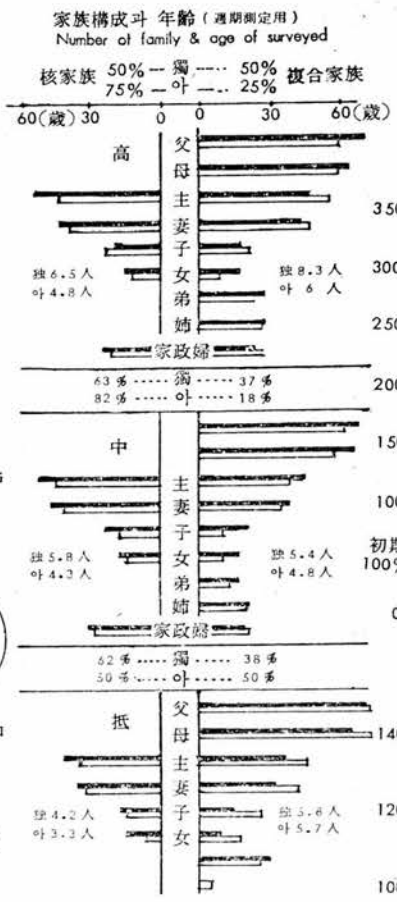
서울人口 (1974)
Population in Seoul
都市人口
農村人口



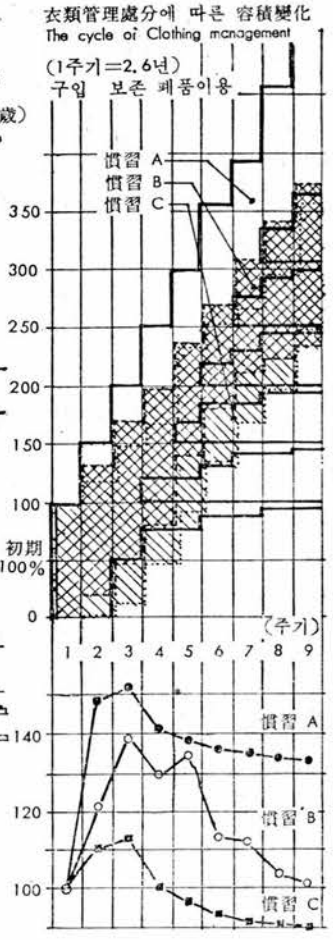
月收入 과 住宅規模 와의 關係
Relation between income & housing areas of 96 H. surveyed



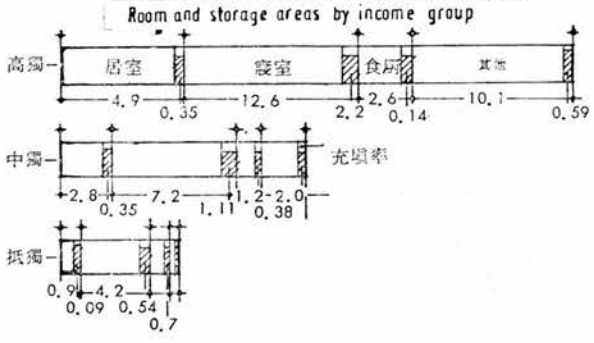
家族構成과 年齡 (調期測定用)
Number of family & age of surveyed



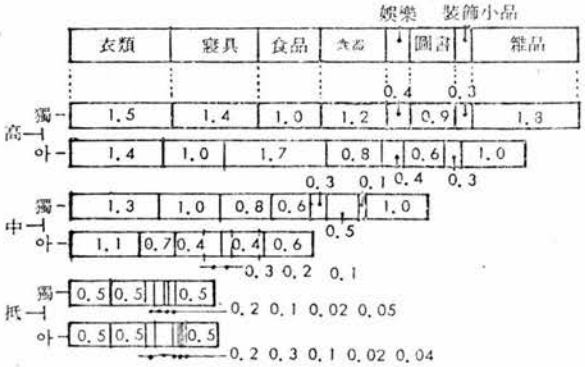
衣類管理處分에 따른 容積變化
The cycle of Clothing management



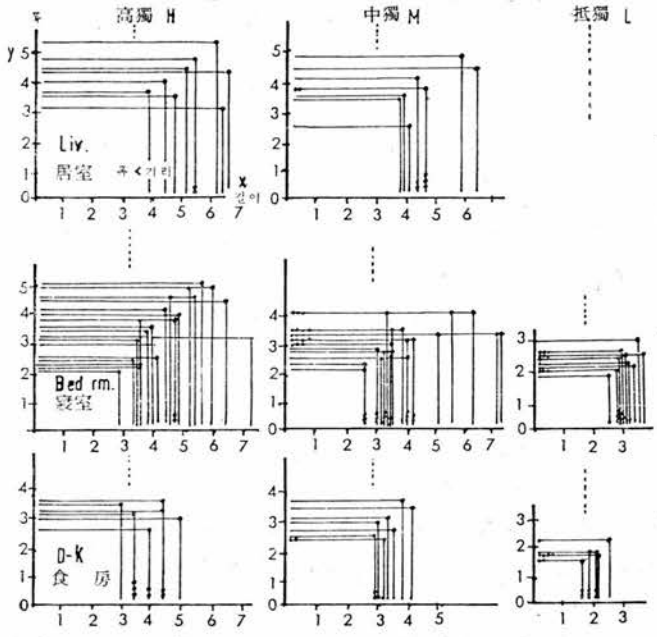
主要室의 居住面積構成比 및 收納設備實態 (㎡)
Room and storage areas by income group



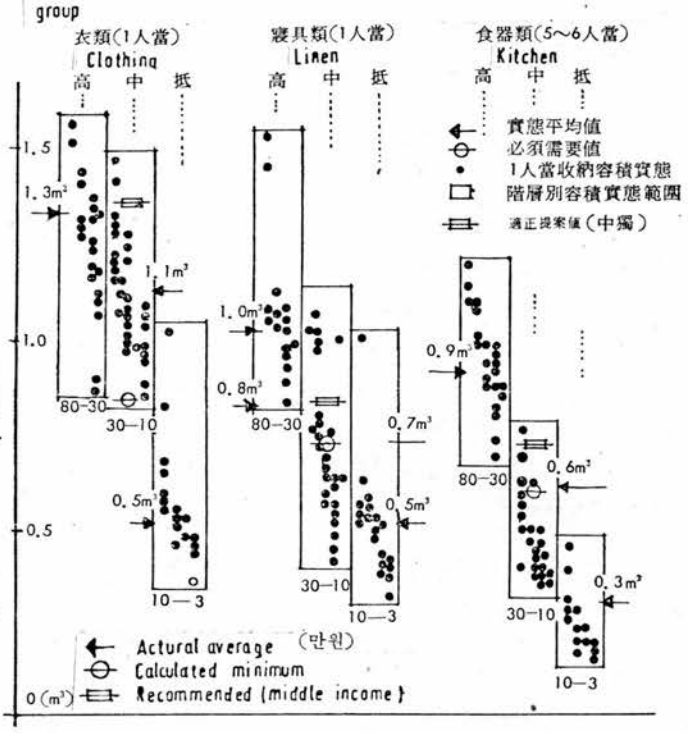
主要收納物別 1人當平均所有容積實態構成 (㎥)
但家政婦所有容積은 1/4로 간주



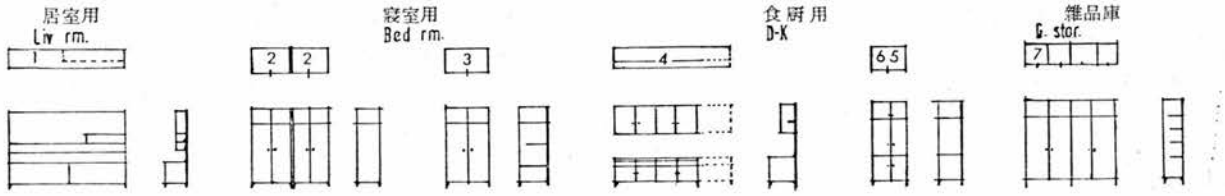
所得階層別 主要室의 面積構成 分布實態 (m)
Actual areas of each room surveyed by income group



獨立住宅 主要收納物의 必須需要量과 所得階層別 1人當 容積分布對比
Volume of storage per person by type of storage and income group



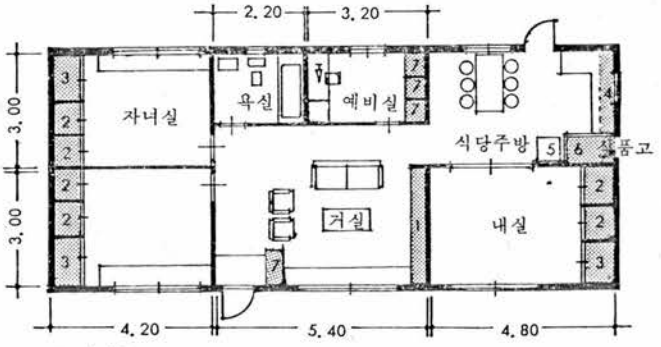
重要收納設備의 設計單位
Optimum design of each storage unit.



1 文化具 3.00×0.45×0.85~2.4m(h)=1.15~3.2m³ /세대용
2 衣類 1.00×0.80×1.05~1.20m(h)=0.84~0.96m³/1人
3 寢具 90×0.80×2.1~2.4m(h)=1.51~1.72m³ / 1人
456 食品食器(2.80×0.4×0.6)+(2.8×0.6×0.6)=1.3m³ /세대용
7 雜品 (0.6×0.8×2.4)×5=5.75m³/세대용

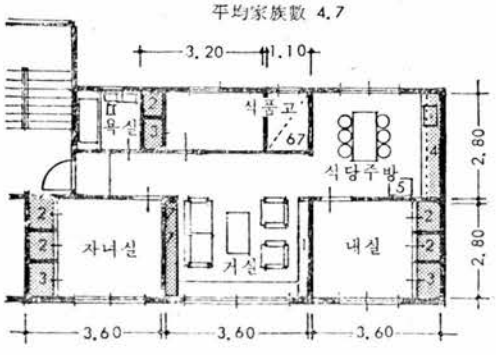
示範住宅 'A·B' 設計案 및 收納設備配置例
Proposal for min. Standard plan between middle & low income house.

	A	B
建築面積	86.4m²(26坪)	53.6m²(16坪)
收納面積	13. m²(15%)	11.9m²(22%)
建築容積	200m³	127m³
收納容積	24m³(12%)	18.9m³(14%)
居住密度	15.3m²~14.4m²	10m²~7.5m²

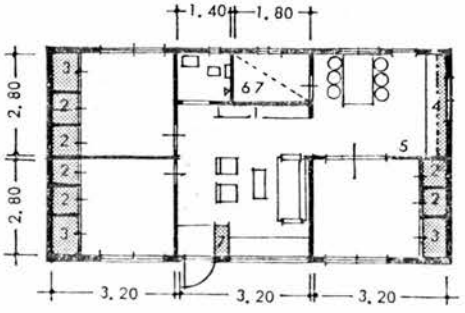


A=中所得層用 適正規模
平均家族數 5.6 (最大收容 6人+家政婦 1人)

中所得層用最小適正規模 아파아트
平均家族數 4.7



B=庶民用最小適正規模
平均家族數 5.3 (最大收容 6人+家政婦 1人)



APPENDIX G

Climate and Weather in Korea.

Temperature.

Korea has short, hot, humid summers and long, cold winters, (November to March) The coldness of the winter (a maximum of 32°F. on a typical January day) suggests to many foreigners that the country is much further north than it actually is. Seoul, at 37°N., is more than 300 miles nearer the Equator than London or Paris, and approximately in the same latitude as Washington, D.C., San Francisco, and Athens. In the winter months, the prevailing wind direction is from the north, and cold, dry air originating over Siberia moves southward across the Korean peninsula. In the summer months of June, July, and August, the airmasses dominating Korean weather come from the tropical waters of the East China Sea. These airmasses arrive warm and moisture laden. By August, both the temperature and the relative humidity rise to the nineties. Spring has variable weather, but there is usually a long period of clear crisp days in the autumn, particularly in October.

Precipitation.

Rainfall is generally associated with the summer onshore monsoon and occurs principally in June, July and August. In general, the total precipitation in South Korea is between 40 and 50 inches.

About 66% of the average year's rainfall is concentrated in the four month rainy season (June - September), 16%

in spring (April and May), and only 18% in the remaining six months (October - March). Because winter is the dry period of the year, not much of the precipitation falls on snow.

Typhoons.

Typhoons are intensive storms of the same origin as the hurricanes of the Atlantic. The periods of greatest probability are 11-20 July and 1 - 10 September, but there are some at other times. After 10 September, the main typhoon track moves east over Japan, and the danger is past.

By the time the typhoons reach Korea they have lost strength and damage caused is due to the intensity of the rain, rather than high winds.

Climatic Regions.

Being a narrow peninsula, Korea might be presumed to have a maritime climate, lacking extremes of heat or cold, with precipitation uniformly distributed through the year. As we have seen, this is not generally true. The summers are tropical and the winters dry and cold.

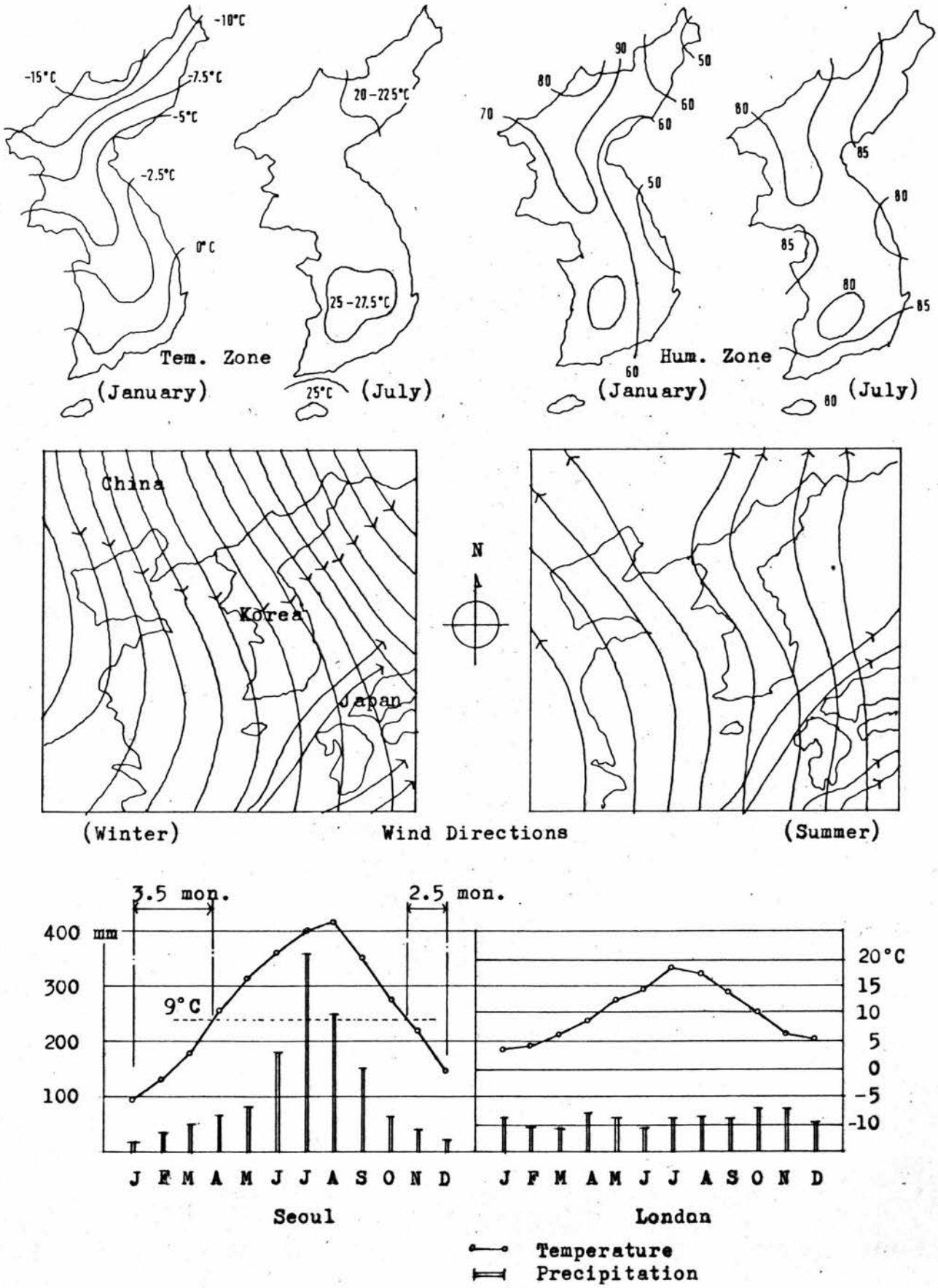


Fig. Temperature, Humidity, Precipitation and Winds by Area

APPENDIX H

The 'Ondol'

The most distinctive feature of Korean house is this old radiant floor heating system 'ondol'.

Under the protection of the thermally-efficient traditional thatch roof, the Ondol helps to overcome the inclemencies of the extreme hot and cold weather.

Under the room floors run stone flues that carry heat from the kitchen fire or external ground level grates. The hot floor warms the room or at least makes its occupants more comfortable in the cold Korean winter. Conversely in summer the floor cools the room by carrying natural ventilation through the stone flues shown in Fig. A.

In the past, the grate which served one room also served the kitchen, so sometimes the kitchen was situated between two other rooms, thus economizing on fuel, which then served the double purpose of cooking and heating. Nowadays however, there are generally separate grates for each room which adds to the cost but is more convenient, allowing greater freedom in room arrangement, or different floor levels between the room and kitchen as shown in Fig. B.

This system is still in use because it is so practical and suitable for bed/sitting rooms, although it is expensive to install in rooms above ground floor.

The 'Dechung'

This wooden floored room has developed from a traditional meeting place which was used for functions and celebrations

but which has evolved into a modern living room. It had no doors or windows like other rooms and was unheated. The present day 'Dechung' is sometimes heated, has a door and windows and is used for a variety of activities, like the western living room.

The 'Changdok-de'

One other important tradition that Korea has retained is the custom of storing large amounts of fresh and preserved food in earthen ware jars which are kept outside. As these are in constant use, the jar storage area should be near the kitchen and also in the sunshine shown in Fig.D.

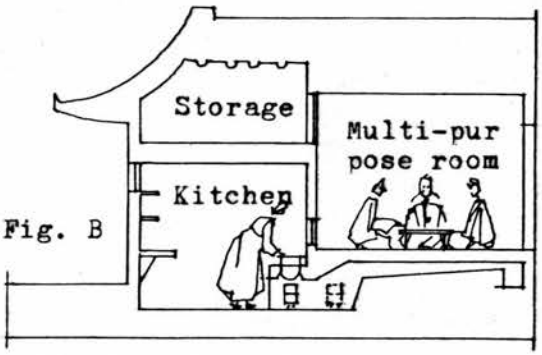
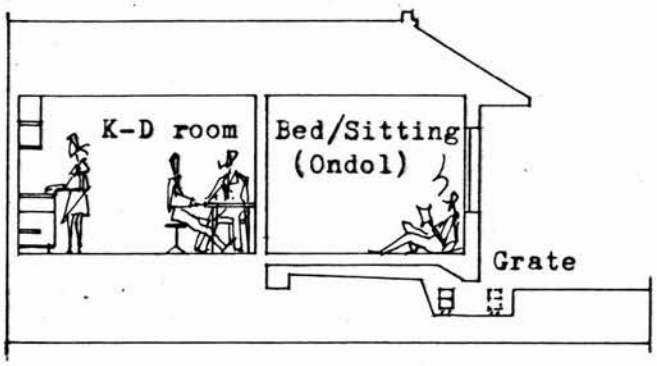


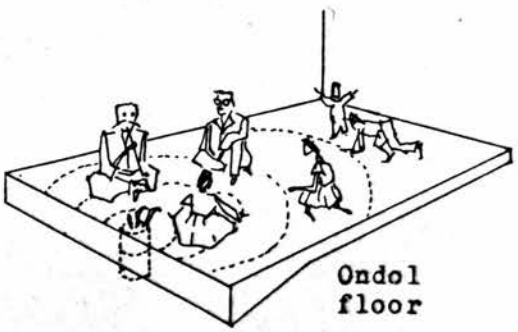
Fig. B

The traditional type of house



The modern type of house

Fig. C



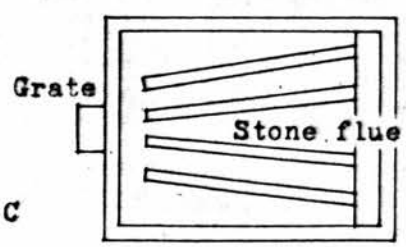
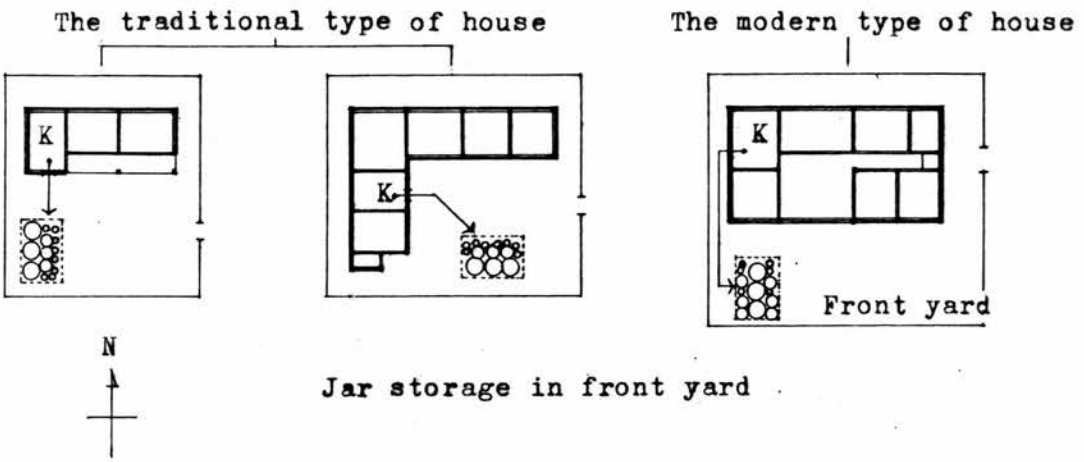


Fig. A



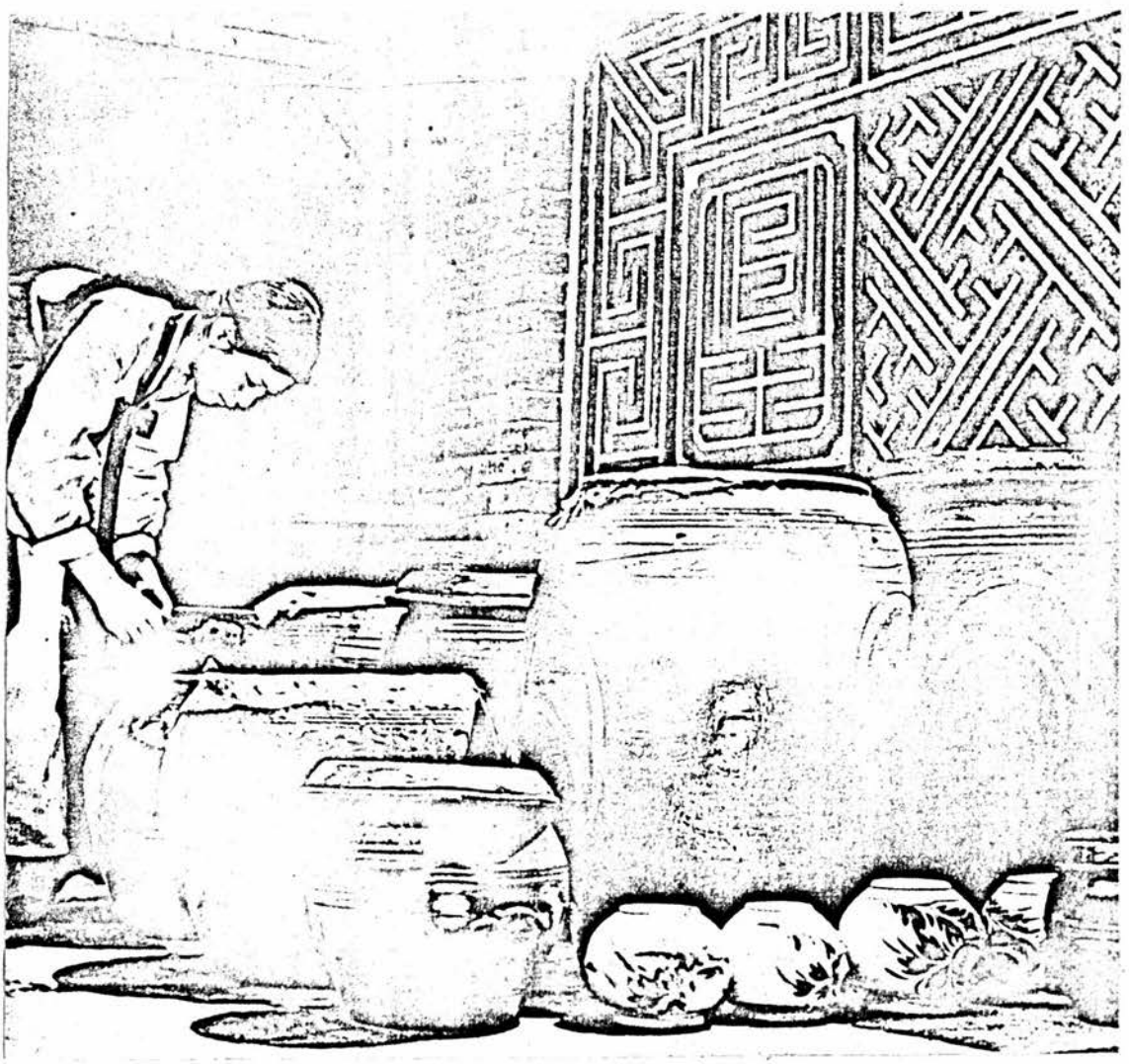
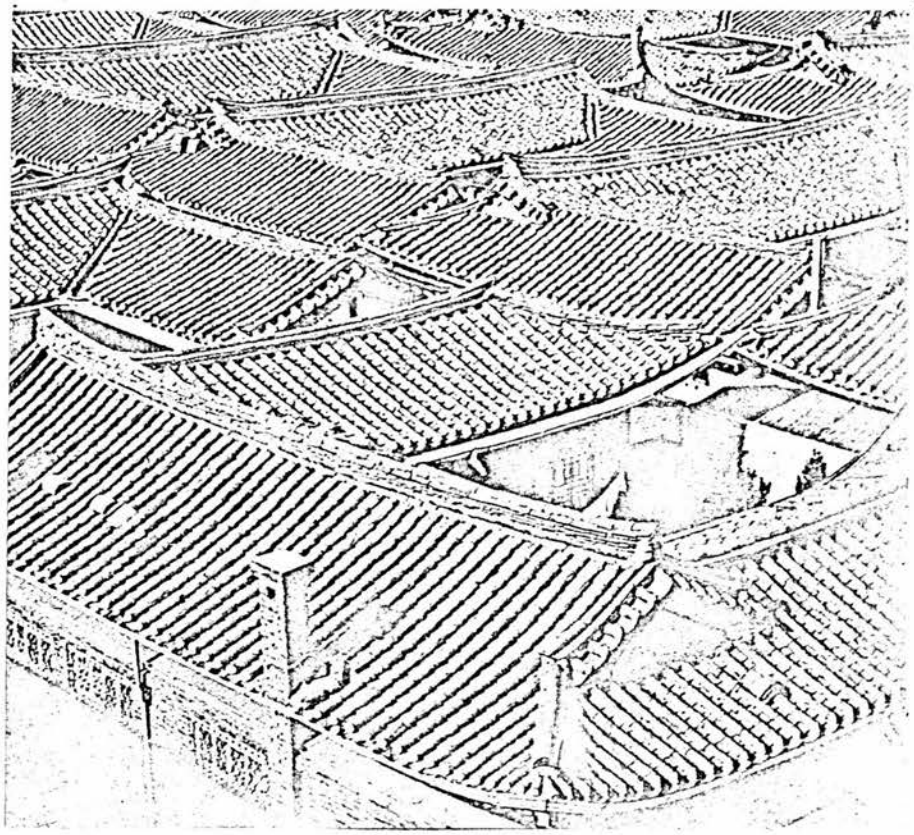
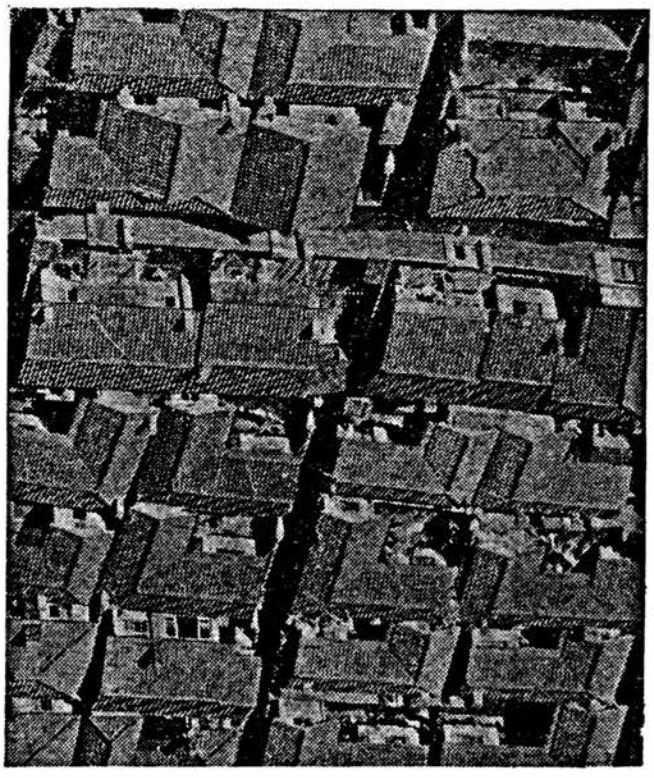


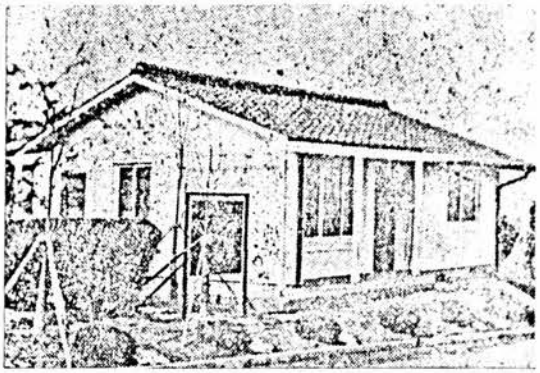
Fig. D Large and Small Jars in the Suny Front Yard

APPENDIX I **Transformations from Old Traditional L-Shaped House to Modern Rectangular Shaped House.**



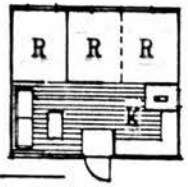
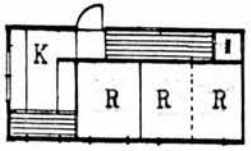
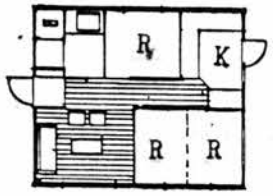
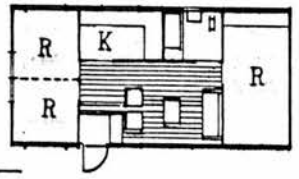
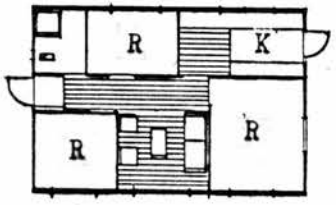
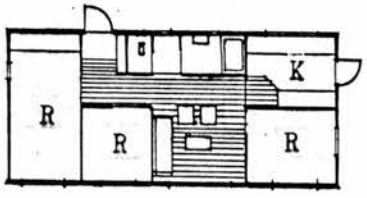
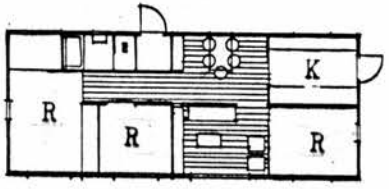
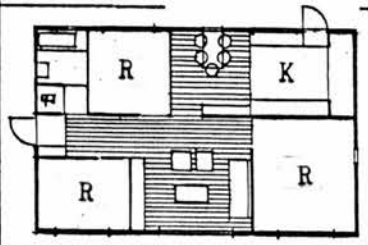
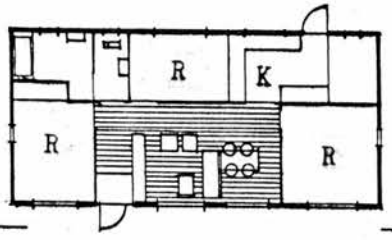
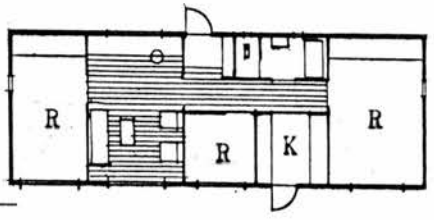
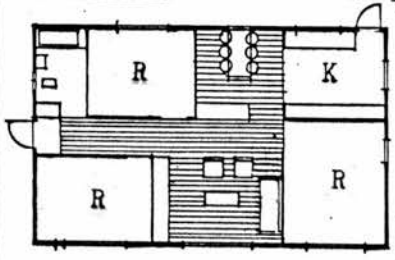
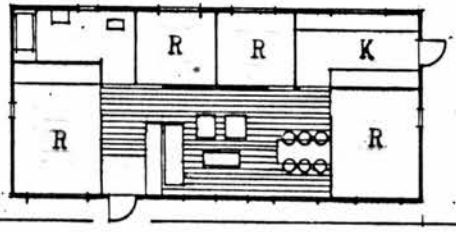
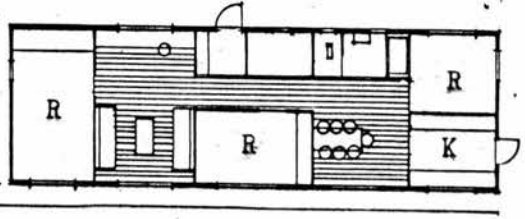
L - Shaped house gives a maximum of privacy and grace in a limited space but has a higher perimeter wall/floor ratio.
The rectangular modern house, with a simple roof, has a lower perimeter wall/floor ratio.



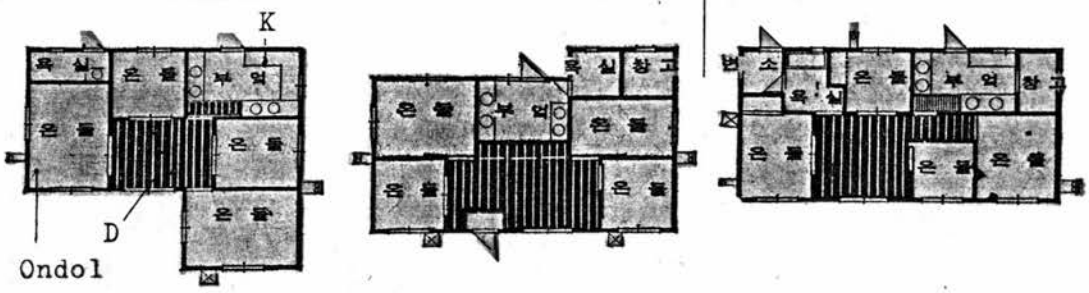
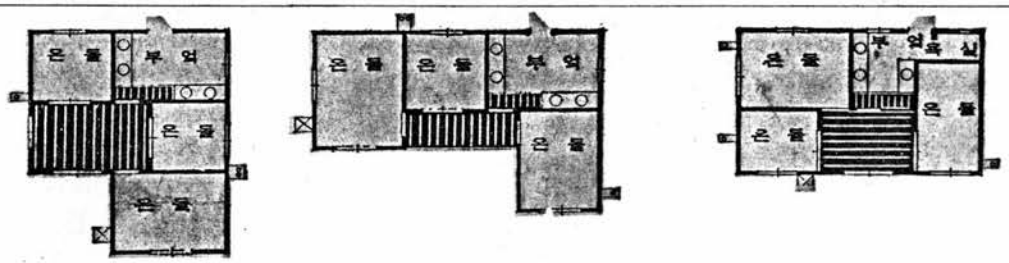
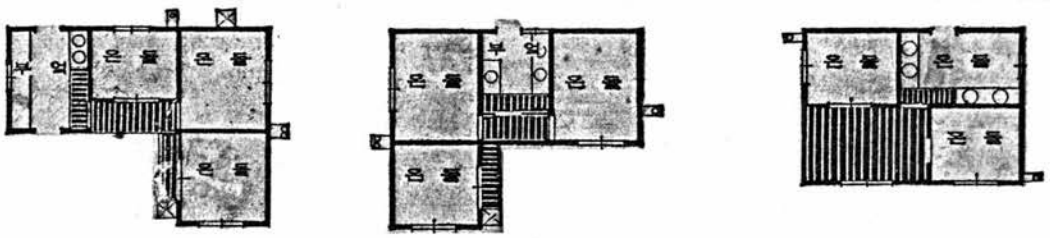
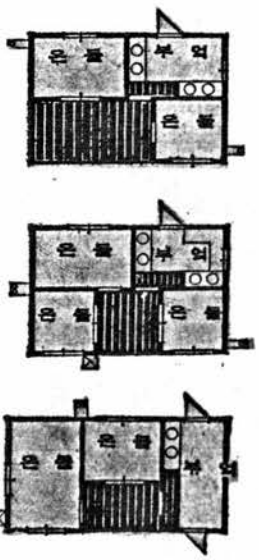


APPENDIX - J House Plans Approved for Loan Purpose by ICA in Korea (1961)

R = Ondol room

X/Y =	1:1 - 1:1.5	1:1.6 - 1:2.0	1:2.1 - 1:2.5	1:2.6 - 1:3.0
D (m^2) -27.0				
37.0				
50.0				
64.0				
81.0				

APPENDIX - K Standard Plans for Farm Houses Recommended by the Government in Korea (1973)

D = (m²)	L-Shape House Plan	Rectangular House Plan
66.0		
60.0		
50.0		
40.0		
33.0		

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